PHYSICAL
SCI. LIB.

TN
24
C3
A33
NO. 143
PT. 4

California. Division of Mines and Geology.

U.C.D. LIBRARY

Mineral Land Classification of the Greater Los Angeles Area

PART IV

CLASSIFICATION OF SAND AND GRAVEL RESOURCE AREAS, SAN GABRIEL VALLEY PRODUCTION-CONSUMPTION REGION

1982

CALIFORNIA DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY

PECIAL REPORT 143
ART IV

U.C.S.B. LIBRARY

STATE OF CALIFORNIA
EDMUND G. BROWN JR.
GOVERNOR

THE RESOURCES AGENCY
HUEY D. JOHNSON
SECRETARY FOR RESOURCES

DEPARTMENT OF CONSERVATION
JAN DENTON
DIRECTOR

DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS
STATE GEOLOGIST

SPECIAL REPORT 143, PART IV

MINERAL LAND CLASSIFICATION OF THE GREATER LOS ANGELES AREA, PART IV:

CLASSIFICATION OF SAND AND GRAVEL RESOURCE AREAS, SAN GABRIEL VALLEY PRODUCTION-CONSUMPTION REGION

By

Susan L. Kohler

Assisted By
Ralph C. Loyd
and Thomas P. Anderson

Directed by James F. Davis
David J. Beeby
and Rudolph G. Strand

1982

CALIFORNIA DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY
1416 Ninth Street, Room 1341
Sacramento, California 95814

Digitized by the Internet Archive
in 2012 with funding from
University of California, Davis Libraries

http://archive.org/details/minerallandclass1434cali

CONTENTS

Page

EXECUTIVE SUMMARY vi

NTRODUCTION 1

ESTABLISHMENT OF MINERAL RESOURCE ZONES 1
- Areas Classified MRZ-1 1
- Areas Classified MRZ-2 1
  - San Gabriel Alluvial Fan 2
  - Eatan Wash 4
  - Devils Gate Reservair 4
  - San Pedra Sandstane 5
- Areas Classified MRZ-3 7
  - Glendara Sauth Hills 7
  - San Jase Hills 7
  - Western Puente Hills 7
  - Repetta Hills 7
  - Mantebella Hills 8
  - Palas Verdes Hills 8
- Areas Classified MRZ-4 8

EVALUATION OF AGGREGATE RESOURCES IN THE SAN GABRIEL
- VALLEY P-C REGION 8
- Urbanized Versus Nanurbanized Land Uses 8
- Data Base 8
- Reserves and Resaurces 9
  - Permitted Resaurces (Reserves) 9
  - Nan-Permitted Resaurces 9
- Mining Canstraints 9
  - Regulatary Canstraints 9
  - Ecanamic Canstraints 10
- Resaurce Sectars 10
  - Sectars A and B - Narthern San Gabriel Wash 11
  - Sectar C - Santa Fe Flaad Cantral Basin and Spillway 11
  - Sectar D - San Gabriel Alluvial Fan, West 12
  - Sectar E - San Gabriel Alluvial Fan, East 12
  - Sectar F - Eatan Wash 12
  - Sectar H - Devils Gate Reservair 12
  - Sectar I - Palas Verdes Hills 12
- Land Use Consideratians 13

ESTIMATED 50-YEAR CONSUMPTION OF AGGREGATE 13
- Aggregate Praductian Recards 13
- Papulatian Recards 13
- Per Capita Cansumptian Rates and Papulatian Densities 13

ALTERNATIVE SOURCES OF AGGREGATE 17
- Sand and Gravel Resaurces af Adjacent P-C Regians 17
  - Resaurce estimates 17
  - Estimated 50-year cansumptian af aggregate in adjacent P-C regians 17
- Crushed Rack Saurces as Alternative 17
  - Metamarphic and granitic racks 17
  - Tertiary valcanic racks 18
- Tertiary Sedimentary Racks as Alternative 18
- Halacene Alluvial Depasits as Alternative 18
- Offshare Sediment Depasits as Alternative 18

CONCLUSIONS 19

SUMMARY OF DESIGNATION FACTORS 19

ACKNOWLEDGMENTS 20

REFERENCES - PART IV 20

ILLUSTRATIONS

Figure 4.1 Index map af U.S. Gealagical Survey 7½ minute quadrangles (Plates 4.5-4.24) cavering the San Gabriel Valley P-C Regian .....

Figure 4.2 Map af the San Gabriel Valley P-C Regian shawing lacatian af the San Gabriel alluvial fan, Eatan Wash, Devils Gate Reservair, and Palas Verdes aggregate resaurce areas .....

Figure 4.3 Sketch map af San Gabriel fan praductian district shawing land awned ar leased by aggregate companies as af January 1981 .....

Figure 4.4 Majar physiagraphic features af the San Gabriel Valley P-C Regian and adjacent areas .....

Figure 4.5 Gealagy af the San Gabriel Valley P-C Regian and adjacent areas .....

Figure 4.6 Cantaur map shawing general thickness af sand and gravel within the San Gabriel fan praductian district .....

Figure 4.7 San Gabriel Valley P-C Regian: papulatian and aggregate praductian recard far years 1961-1977 .....

Figure 4.8 San Fernanda Valley P-C Regian: papulatian and aggregate praductian recard far years 1961-1976 .....

Figure 4.9 Orange Caunty-Temescal Valley P-C Regian: papulatian and aggregate praductian recard far years 1960-1977 .....

Figure 4.10 Claremant-Upland P-C Regian: papulatian and aggregate praductian recard far years 1961-1977 .....

Figure 4.11 Prajected papulatians af the San Gabriel Valley, San Fernanda Valley, Orange Caunty-Temescal Valley and Claremant-Upland P-C regians ta the year 2030 .....

Figure 4.12 Annual per capita cansumptian af aggregate in the San Gabriel Valley, San Fernanda Valley, Orange Caunty-Temescal Valley and Claremant-Upland P-C regians far years 1961-1977 .....

Figure 4.13 Prajected 50-year per capita cansumptian far the San Gabriel Valley P-C Regian .....

Figure 4.14 Camparisan af papulatian densities far San Gabriel Valley, San Fernanda Valley, Orange Caunty-Temescal Valley, and Claremant-Upland P-C regians far years 1960-1976 .....

TABLES

Table 4.1 List af lead agencies (caunty and incarparated city gavernments) lacated within the San Gabriel Valley P-C Regian .....

Table 4.2 Aggregate resaurces af the San Gabriel Valley P-C Regian .....

Table 4.3 Prajected aggregate cansumptian ta the year 2030 far the San Gabriel Valley, San Fernanda Valley, Orange Caunty-Temescal Valley, and Claremant-Upland P-C regians .....

Table 4.4 Aggregate resaurces af the San Fernanda Valley, Claremant-Upland, and Orange Caunty-Temescal Valley P-C regians .....

Table 4.5 Summary af Designatian Factars far the San Gabriel Valley P-C Regian .....

PLATES

Plate 4.1 Generalized aggregate resaurce classificatian map - San Gabriel Valley and adjacent praductian-cansumptian regians

Plate 4.2 San Gabriel alluvial fan, generalized gealagical sectians shawing sand and gravel distributian

Plate 4.3 San Gabriel alluvial fan - aggregate resaurce Sectars A-E

Plate 4.4 Eatan Wash, Devils Gate Reservair, and Palas Verdes resaurce areas - aggregate resaurce sectars F, H, and I

Plate 4.5 Mineral land classificatian map; Pasadena quadrangle

Plate 4.6 Mineral land classification map; Mt. Wilsan quadrangle

Plate 4.7 Mineral land classificatian map; Azusa quadrangle

Plate 4.8 Mineral land classification map; Glendara quadrangle

Plate 4.9 Mineral land classification map; Hallywaad quadrangle

Plate 4.10 Mineral land classificatian map; Las Angeles quadrangle

Plate 4.11 Mineral land classification map; El Monte quadrangle

Plate 4.12 Mineral land classificatian map; Baldwin Park quadrangle

Plate 4.13 Mineral land classificatian map; San Dimas quadrangle

Plate 4.14 Mineral land classificatian map; Venice quadrangle

Plate 4.15 Mineral land classificatian map; Inglewaad quadrangle

Plate 4.16 Mineral land classificatian map; Sauth Gate quadrangle

Plate 4.17 Mineral land classificatian map; Whittier quadrangle

Plate 4.18 Mineral land classification map; La Habra quadrangle

Plate 4.19 Mineral land classification map; Redonda Beach quadrangle

Plate 4.20 Mineral land classificatian map; Torrance quadrangle

Plate 4.21 Mineral land classificatian map; Long Beach quadrangle

Plate 4.22 Mineral land classification map; Las Alamitos quadrangle

Plate 4.23 Mineral land classification map; San Pedro quadrangle

Plate 4.24 Mineral land classificatian map; Seal Beach quadrangle

EXECUTIVE SUMMARY

Bosed upon the projected population increose ond the predicted per copito consumption rotes, opproximotely 780 million tons of oggregote will be required to sotisfy demond in the Son Gobriel Volley Prbduction-Consumption Region to the yeor 2030.

Current *reserves* (aggregote moteriols believed to be acceptoble for commerciol use thot exist within property owned or leosed by on aggregote producing compony ond for which permission ollowing extroction and processing has been gronted by the proper outhorities) totol opproximotely 280 million tons, which is obout one-third (18 yeor supply) of the requirements needed for the 50-yeor period.

Non-permitted resources (potentiolly usoble aggregote moteriols thot moy be mined in the future but for which no use permit ollowing extroction hos been gronted, or for which development hos not been definitely estoblished to be feosible bosed upon current technology or economic conditions) within the Son Gobriel Volley Production-Consumption region totol over 3 billion tons. Almost oll of these resources are contoined in the San Gobriel River olluvial fon. Over half of the 3 billion tons lies beneoth the Sonto Fe Dom Recreotion Areo. The remoinder of the resources lies beneoth other open-spoce lond ond under properties currently being mined.

The Son Gobriel Volley P-C Region's 18-year reserve supply of oggregote could be premoturely depleted by exportotion of sond ond grovel to neighboring P-C regions, oll three of which may experience o shortoge of oggregote within the next 20 yeors.

CLASSIFICATION OF SAND AND GRAVEL RESOURCE AREAS SAN GABRIEL VALLEY PRODUCTION-CONSUMPTION REGION

INTRODUCTION

Land in the San Gabriel Valley Production-Consumption (P-C) Region of the greater Los Angeles metropolitan area (See Special Report 143, Part I, Plate 1.2) has been classified by the California Division of Mines and Geology (CDMG) according to the presence or absence of significant sand and gravel deposits suitable for use in construction grade aggregate). The land classification is presented in the form of maps showing Mineral Resource Zones (MRZs) as described in Part I of SR 143. Twenty such maps on the U.S. Geological Survey topographic quadrangle bases accompany this report (Plates 4.5-4.24). Refer to Figure 4.1 for an index to quadrangle maps covering the San Gabriel Valley P-C Region. A list of lead agencies located within the San Gabriel Valley P-C Region is presented on Table 4.1

ESTABLISHMENT OF MINERAL RESOURCE ZONES

The boundaries of the San Gabriel Valley P-C Region circumscribe the primary marketing region for the San Gabriel fan sand and gravel production district, one of the major sand and gravel production districts in the greater Los Angeles metropolitan area (see SR 143, Part I, pages 6 and 8, Figures 1.2 and 1.3). Mineral Resource Zones (as defined by the "Guidelines for Classification and Designation of Mineral Lands," Special Report 143, Part I, Appendix A-3, p. 25) within the San Gabriel Valley P-C Region were delineated on the basis of a sand and gravel resource appraisal which included study of pertinent geologic reports and maps, field investigations, analysis of drill-hole data collected from the past 75 years, and inspection of aerial photographs.

Areas Classified MRZ-1

Plate 4.1 shows the general localities of the San Gabriel Valley P-C Region which are classified as MRZ-1. These are areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence (see "Guidelines for Classification and Designation of Mineral Lands," Appendix A-3 in SR 143, Part I, p. 32).

Many areas classified MRZ-1 occur within the interior parts of the Los Angeles basin where well-log data indicate the presence of sedimentary deposits that are composed predominantly of fine-grained material unsuitable for use as aggregate. In addition, several MRZ-1 areas are located in hilly or mountainous terrane. Classification of the latter areas was made mainly on the basis of available geologic mapping and field investigation. These areas include parts of the Palos Verdes, San Jose, Repetto, and Puente Hills. The sedimentary rocks that are unsuitable for use as aggregate include shale, siltstone, diatomite, and limestone of the Monterey Formation; platy siltstone, diatomaceous siltstone, shale, and dolomite of the Puente Formation; well-bedded siltstone and shale of the Topanga Formation; and massive siltstone of the Repetto Formation.

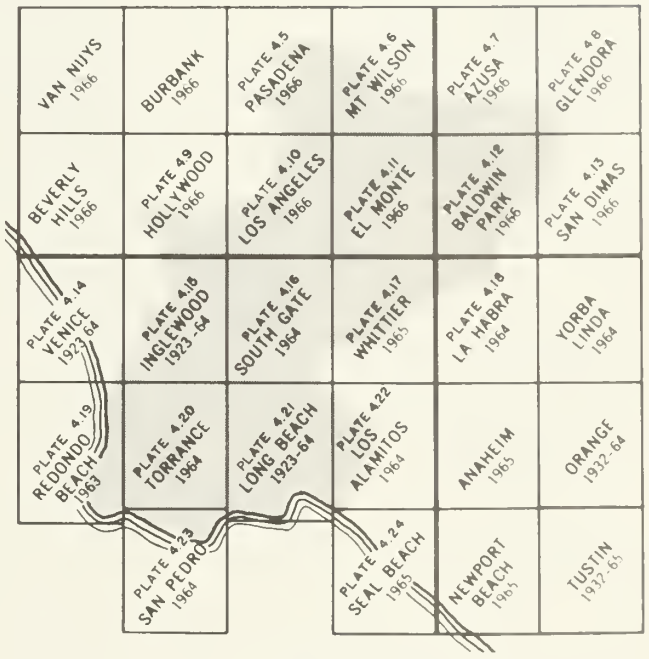

VAN NUYS 1966
BURBANK 1966
PLATE 4.5 PASADENA 1966
PLATE 4.6 MT WILSON 1966
PLATE 4.7 AZUSA 1966
PLATE 4.8 GLENDORA 1966
BEVERLY HILLS 1966
PLATE 4.9 HOLLYWOOD 1966
PLATE 4.10 LOS ANGELES 1966
PLATE 4.11 EL MONTE 1966
PLATE 4.12 BALDWIN PARK 1966
PLATE 4.13 SAN DIMAS 1966
PLATE 4.14 VENICE 1923-64
PLATE 4.15 INGLEWOOD 1923-64
PLATE 4.16 SOUTH GATE 1964
PLATE 4.17 WHITTIER 1965
PLATE 4.18 LA HABRA 1964
YORBA LINDA 1964
PLATE 4.19 REDONDO BEACH 1963
PLATE 4.20 TORRANCE 1964
PLATE 4.21 LONG BEACH 1923-64
PLATE 4.22 LOS ALAMITOS 1964
ANAHEIM 1965
ORANGE 1932-64
PLATE 4.23 SAN PEDRO 1964
PLATE 4.24 SEAL BEACH 1965
NEWPORT BEACH 1965
TUSTIN 1932-65

Figure 4.1 Index map of U.S. Geological Survey 7½ minute quadrangles (Plates 4.5-4.24) covering the San Gabriel Valley P-C Region.

Areas Classified MRZ-2

Plate 4.1 shows the general localities of the San Gabriel Valley P-C Region which are classified as MRZ-2. These are areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists ("Guidelines for Classification and Designation of Mineral Lands," Appendix A-3 in SR 143, Part I, p. 32).

The geologic setting of the sand and gravel resources in the San Gabriel Valley P-C Region is a broad system of coalescing alluvial fans that have filled the San Gabriel Valley floor at the base of the San Gabriel Mountains. Alluvial fan deposits are formed when mountain streams carrying large volumes of sand and gravel enter into a valley or plain. The abrupt change in slope causes a sudden decrease in the transporting energy of the stream, thus resulting in deposition of coarse gravel material near the apex of the fan and finer material further downstream.

Table 4.1 List of lead agencies (county and incorporated city governments) located within the San Gabriel Valley P-C Region. Cities that have active aggregate operations within their jurisdictional boundaries are denoted by asterisks. Cities that have land within their jurisdiction classified MRZ-2 are denoted by Δ.

LOS ANGELES COUNTY

Alhambra	Inglewood	Rancho Palos Verdes
Δ Arcadia	* Δ Irwindale	Redondo Beach
* Δ Azusa	La Canada Flintridge	Rolling Hills
Δ Baldwin Park	Lakewood	* Δ Rolling Hills Estates
Bell	Δ La Puente	Δ Rosemead
Bellflower	Lawndale	Δ San Dimas
Bell Gardens	Lomita	Δ San Gabriel
Bradbury	Long Beach	San Marino
Carson	Δ Los Angeles	Δ Santa Fe Springs
Commerce	Lynwood	Δ Sierra Madre
Δ Covina	Manhattan Beach	Signal Hill
Cudahy	Maywood	Δ South El Monte
Δ Downey	Δ Monrovia	South Gate
Δ Duarte	Δ Montebello	Δ South Pasadena
Δ El Monte	Monterey Park	Δ Temple City
Gardena	Norwalk	Δ Torrance
Glendale	Palos Verdes Estates	Δ Vernon
Δ Glendora	Paramount	Walnut
Hawthorne	* Δ Pasadena	Δ West Covina
Δ Huntington Park	Δ Pico Rivera	Whittier
Δ Industry		

Alluvial fan deposits suitable as a source of aggregate are confined to the northern portion of the valley.

In order for a deposit of sand and gravel to be categorized as significant, it must satisfy the criteria given in the "Guidelines for Classification and Designation of Mineral Lands," (see Appendix A-3 in SR 143, Part I). In addition, the geologic factors that resulted in the formation of the deposit must be understood clearly enough so that reasonable interpretations can be made from surface exposure of the material and from drill-hole data.

Deposits within the San Gabriel Valley P-C Region that satisfy these criteria occur within the San Gabriel alluvial fan, Devils Gate Reservoir, Eaton Wash, and the Palos Verdes Hills (see Figure 4.2).

SAN GABRIEL ALLUVIAL FAN

One of the most significant sand and gravel deposits in the greater Los Angeles area occurs in the north-central San Gabriel Valley, in and near the City of Irwindale, California. The voluminous amount of aggregate material in the area is contained in the upper portion of the Holocene (recent geologic time period) San Gabriel alluvial fan (Figure 4.2).

The sedimentary material forming the San Gabriel alluvial fan was derived from rocks exposed in the San Gabriel Mountains to the north. The sediments are poorly sorted and range from boulders exceeding 8 feet in diameter to clay size particles. Coarse material within the fan consists of fresh durable rock clasts, the most common of which are composed of quartz diorite, granodiorite, granitic gneiss and schist. A mixture of gravel, sand, silt, and clay is found throughout all parts of the San Gabriel alluvial fan. Cobbles and boulders are predominantly deposited at the apex of the fan, and the average particle size decreases toward the sides and base of the fan.

The San Gabriel alluvial fan is underlain by older alluvial (Pleistocene) fan deposits which are exposed in parts of the eastern and western San Gabriel Valley. Unlike the Holocene San Gabriel alluvial fan, the older deposits contain large amounts of weathered material, which makes them unsuitable as sources of aggregate material. The geologic sections presented on Plate 4.2 show the general nature of sand, gravel, and clay distribution in portions of the San Gabriel alluvial fan.

The potential value of the San Gabriel alluvial fan as a source of quality sand and gravel for use as construction material was recognized long ago. Although no known records indicate when sand and gravel was first extracted from the fan, it probably was prior to 1900.

Aggregate production from the San Gabriel alluvial fan is taking place in the vicinity of the City of Irwindale, located 1 miles northeast of downtown Los Angeles (Figure 4.2). At the present time, a total of eight operations are active in this production district (Figure 4.3). One of the largest sand and gravel producing operations in the western United States, the Livingston-Graham, Inc., El Monte plant, is located here. Other majo

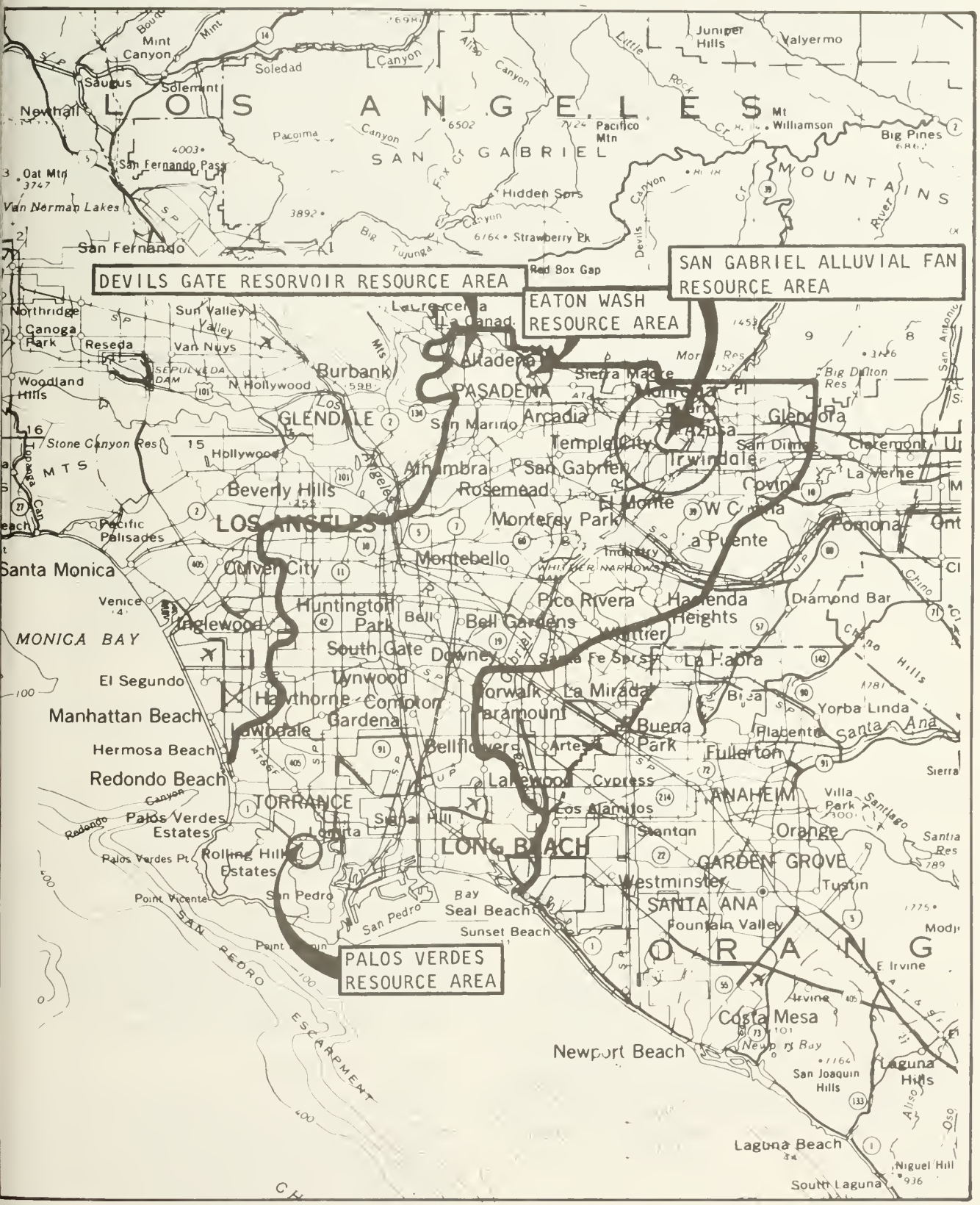


Figure 4.2 Map of the San Gabriel Valley P-C Regian showing lacation af the San Gabriel alluvial fan, Eatan Wash, Devils Gate Reservoir, and Palas Verdes Resaurce Areas.

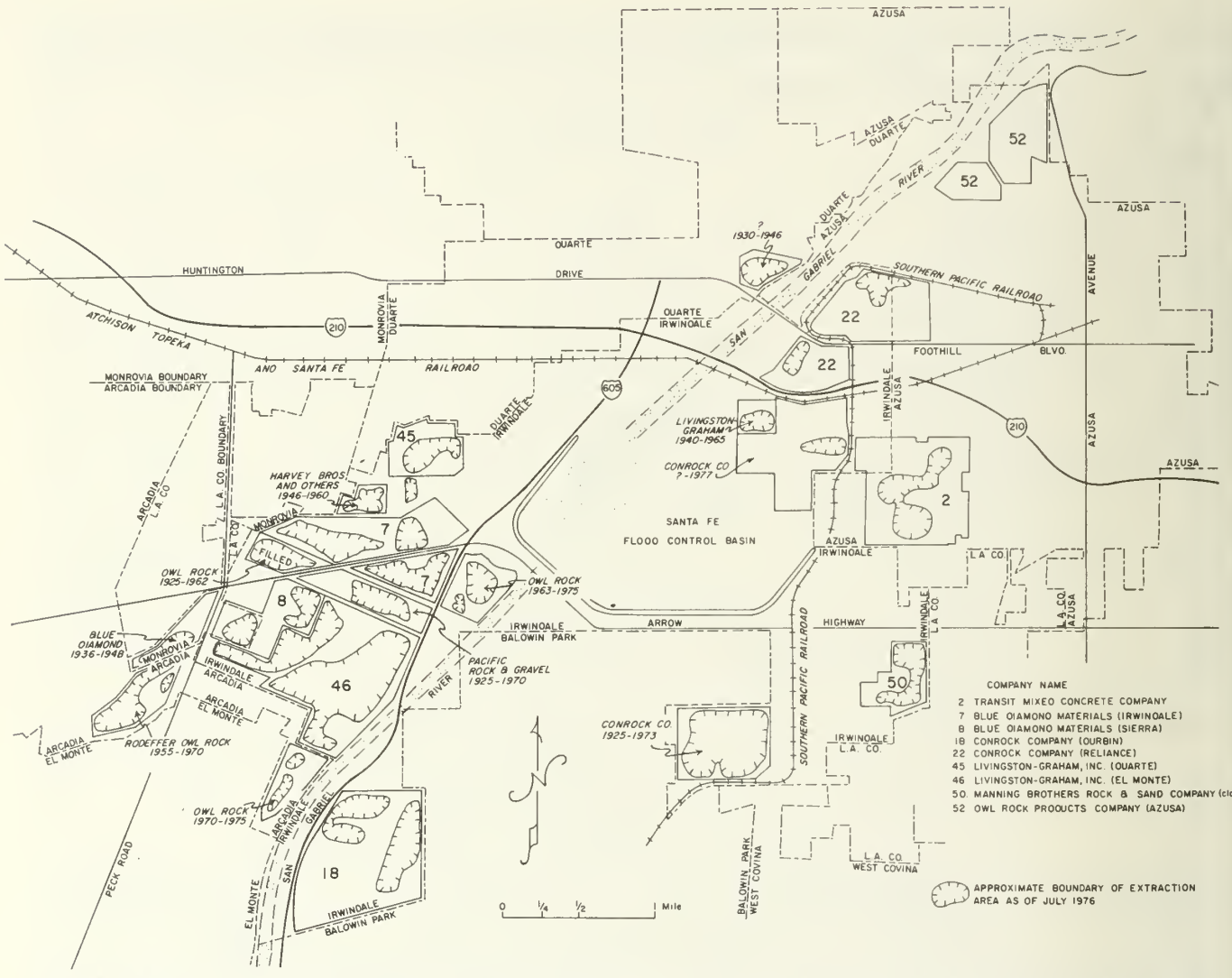


Figure 4.3 Sketch map of the San Gabriel Valley fan production district showing land owned or leased by aggregate companies as of January, 1981.

operations are the Owl Rock Products Co., Azusa plant, Blue Diamond Santa Fe plant, Transit Mixed Concrete plant, and Conrock's Durbin and Reliance plants. All of these plants have rated capacities of more than 1,000 tons per hour; the Livingston-Graham plant capacity is 3,000 tons per hour.

The annual production from the San Gabriel alluvial fan for the past 9 years has ranged from 9 million to 18.5 million short tons of processed aggregate. Over the 9-year period of 1970-78, average annual sales of aggregate from this district was over 14 million tons. Since 1960, the San Gabriel alluvial fan has yielded over 320 million tons of aggregate. This tonnage amounts to more than one-third of the total output of the entire greater Los Angeles classification project area. Refer to Evans and others (1979) for detailed discussions of the San Gabriel fan production district.

EATON WASH

Eaton Wash emanates from Eaton Canyon on the south slope of the San Gabriel Mountains (Plate 4.4). The deposit within Eaton Wash extends southward for a distance of approximately 5 miles and has an average width of 0.5 miles. Except for the northernmost portion, most of the wash has been urbanized.

The deposit is composed of fresh, durable detrital material. Grain sizes range from clay-size particles to boulders several feet in diameter. The sand-to-gravel ratio (based upon volume) is about 2:1. Clast types are predominantly granitic rocks similar to those found in the San Gabriel alluvial fan. Asphaltic sand and gravel and concrete sand has been produced from the Eaton Wash deposit, but there are no current operations.

DEVILS GATE RESERVOIR

The Devils Gate reservoir deposit is situated within the Arroyo Seco drainage about two miles east of the City of La Canada (see Plate 4.4). The deposit is in an alluvial channel of Holocene age which drains a large portion of the San Gabriel Mountains north of Pasadena. During periods of heavy rainfall, material is transported along the Arroyo Seco and is impounded due to the presence of Devils Gate Dam. Consequently, material must periodically be removed from the reservoir area to maintain the effectiveness of the dam.

Aggregate material within the Devils Gate deposit has an ıost equal ratio (based upon volume) of sand to gravel. The ırsest material consist of boulders averaging about 3 feet in meter, with some attaining dimensions of up to 6 feet. Com- n clast types identified include granite, granodiorite, quartz rite, and quartz feldspathic gneisses and schists.

Mining at the Devils Gate reservoir area began in the early 50s by Western Aggregate Co. In 1969, Pasadena Aggregate rted mining and processing in the area; the operation has ıerally been continuous since then. The company operates der a lease issued by the City of Pasadena and administered the Los Angeles County Flood Control District. Material m the mine is processed in a conventional crushing, washing, d screening operation.

N PEDRO SANDSTONE

The San Pedro Sandstone is a Pleistocene marine deposit ich outcrops along the northern and northeastern fringes of Palos Verdes Hills (Figures 4.4 and 4.5). This sandstone forms an almost continuous belt extending from the City of San Pedro northwestward to Malaga Cove. Historically, mining of the San Pedro Sandstone has taken place along a 2-mile strip in a northwesterly direction from the current mining site in the City of Rolling Hills Estates. This 2-mile stretch is classified as MRZ-2. The remaining areas underlain by San Pedro Sandstone are classified as MRZ-3 because of lack of adequate data concerning the quality of the material.

The depositional environment of the San Pedro Sandstone is believed to be cold-water marine probably corresponding to a period of maximum glaciation (Woodring, W.P., 1946). Regional tectonic uplift of the entire Palos Verdes Peninsula has left these marine deposits stranded hundreds of feet above the present sea level.

The San Pedro Sandstone consists predominantly of quartz and feldspathic sands, most of which are poorly consolidated, relatively unaltered, coarse, and uncemented. The sandstone contains some minor (less than 2%) pebbly gravel, but the deposit is essentially a sand deposit. Much of the sandstone is

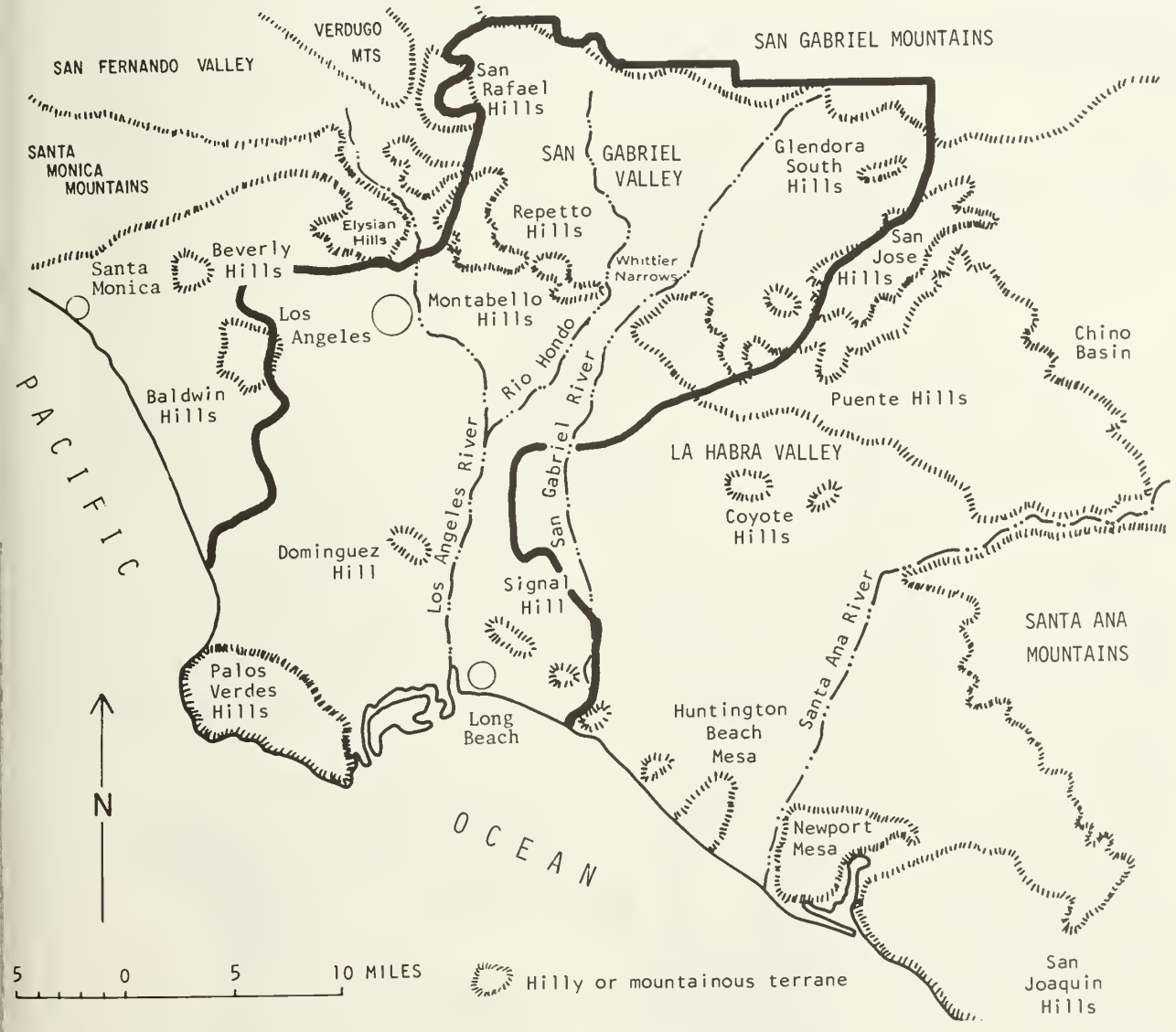
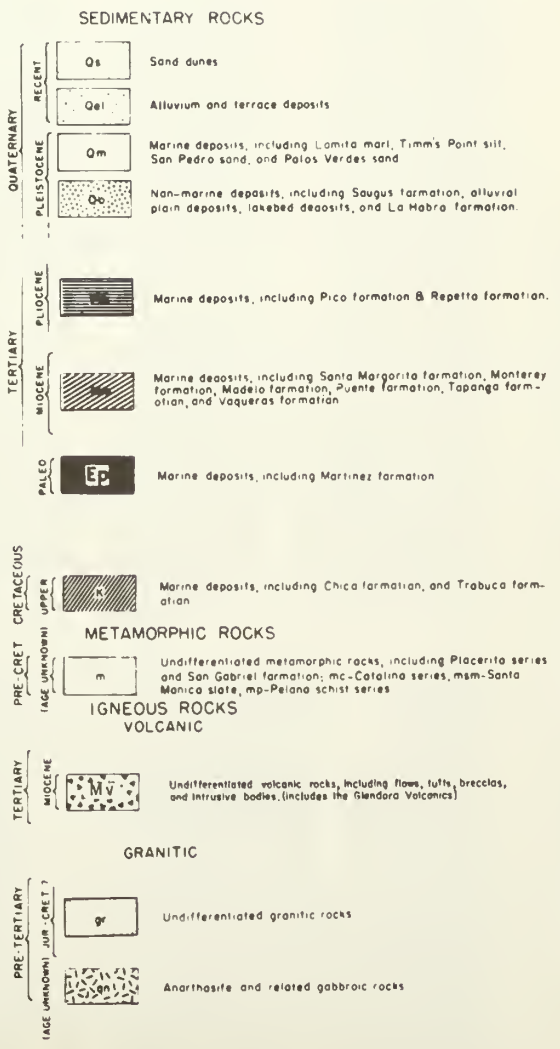


Figure 4.4 Major physiographic features of the San Gabriel Valley P-C Region and adjacent areas.


SEDIMENTARY ROCKS
QUATERNARY
RECENT
Qs Sand dunes
Qal Alluvium and terrace deposits
PLEISTOCENE
Qm Marine deposits, including Lomita marl, Timm's Point silt, San Pedro sand, and Palos Verdes sand
Qc Non-marine deposits, including Saugus formation, alluvial plain deposits, lakebed deposits, and La Habra formation
TERTIARY
PLIOCENE
Marine deposits, including Pico formation & Repetto formation.
MIOCENE
Marine deposits, including Santa Margarita formation, Monterey formation, Modelo formation, Puente formation, Topanga formation, and Vaqueras formation
PALEO
Ep Marine deposits, including Martinez formation
CRETACEOUS
UPPER
Marine deposits, including Chica formation, and Trabuca formation
METAMORPHIC ROCKS
PRE-CRET
AGE UNKNOWN
m Undifferentiated metamorphic rocks, including Placerita series and San Gabriel formation; mc-Catalina series, msm-Santa Monica slate, mp-Pelona schist series
IGNEOUS ROCKS
VOLCANIC
TERTIARY
MIOCENE
Mv Undifferentiated volcanic rocks, including flows, tuffs, breccias, and intrusive bodies. (includes the Glendora Volcanics)
GRANITIC
PRE-TERTIARY
AGE UNKNOWN, JUR.-CRET.?
gr Undifferentiated granitic rocks
an Anorthosite and related gabbroic rocks

Modified from: Woodford, A.O., and others, 1954: Geology of the Los Angeles Basin, California Division of Mines and Geology, Bulletin 170, vol. 50, No. 3 and 4, Plate 4.

Figure 4.5 Geology of the San Gabriel Valley P-C Region and adjacent areas.

ped by late Pleistocene to Holocene, non-marine terrace cov- anging in thickness from a few feet to 100 feet (Woodring, P., 1946). Most of this terrace cover is less than 50 feet in ckness.

Operations at the currently operating Chandler's Palos Verdes ie began in 1921 and have been continuous since 1937. This ie only active operation in the Palos Verdes area. Because the osit is composed almost solely of sand, coarse aggregate is orted from the San Gabriel fan production district in order make Portland cement concrete at Chandler's batch plant.

Areas Classified MRZ-3

Plate 4.1 shows the general localities of the MRZ-3 areas hin the San Gabriel Valley P-C Region. These areas incorpo- e land containing mineral deposits, the significance of which not be evaluated from available data (see Appendix A-3 in 143, Part I, p. 32). MRZ-3 areas in the San Gabriel Valley C Region include both valley regions and hilly or mountainous rane. MRZ-3 areas located in valley or basin regions are erally underlain by alluvial deposits of Quaternary age. These osits contain sand and gravel of which little is known because nadequate subsurface data. MRZ-3 areas located in hilly or untainous terrane are generally underlain by sedimentary osits of Tertiary age, crystalline basement rock, or volcanic ks (Plate 4.1 and Figure 4.5). Very little subsurface or sur- e data of the type needed to evaluate the suitability of these ks for use in Portland cement concrete is available. Conse- ently, these areas were classified as MRZ-3.

Those MRZ-3 areas that are most promising as potential rces of aggregate material are discussed in the "Alternative rces of Aggregate" section beginning on page 17.

ENDORA SOUTH HILLS

The Glendora South Hills, a low ridge about a mile southeast the City of Glendora, are classified as MRZ-3 (Figure 4.4). ck units which comprise these hills belong to the Glendora lcanics and the Topanga Formation (Figure 4.5). The Glen- a Volcanics, which consist of andesites and undifferentiated canics, are exposed along the southern side of the hills. Crys- ine volcanic rocks are often used as a source of crushed rock, ecially where there is a shortage of naturally occurring coarse gregate material. However, there is no known history of min- concrete aggregate material within the Glendora Volcanics. order to classify these rocks as a crushed rock resource, ysical and chemical properties of these rocks need to be eva- ted. A discussion of Tertiary volcanic rocks, which includes Glendora Volcanics, is given under the "Crushed Rock rces as Alternatives" section of this report, page 17.

The Topanga Formation, consisting of coarse- to fine-grained, ssive-bedded sandstone and conglomerate, are exposed along northern side of the Glendora South Hills. These rocks have n assigned an MRZ-3 classification on the basis of lithologic criptions and field observations. There is no history of mining se rocks.

N JOSE HILLS

Some of the Tertiary sedimentary formations exposed in the thwestern San Jose Hills contain deposits that are potential rces of aggregate and have been classified as MRZ-3. These are sandstone, pebbly sandstone, and conglomerates, most of which are assigned to the Soquel Member of the Puente Formation and the lower member of the Fernando Formation.

The Soquel Member of the Puente Formation consists of poorly cemented feldspathic sandstone and pebbly sandstone, interbedded siltstone, and local lenses of pebble conglomerate. In the past, aggregate was produced from a conglomerate lens of the Soquel Member in an area east of El Toro Marine Air Station (located in the adjacent Orange County-Temescal Valley P-C Region). It is not known whether conglomerate lenses of the Soquel Member within the San Jose Hills have similar physical and chemical properties to those mined in the east El Toro area.

The lower member of the Fernando Formation consists of alternating, massive silty sandstone and pebble conglomerate with local beds of intraformational breccia. There is no known history of mining of this lower member within the San Gabriel Valley P-C Region. These sediments were classified as MRZ-3 solely on the basis of lithologic descriptions and field observations.

In addition to these sedimentary units, areas underlain by rocks belonging to the Glendora Volcanics, which are exposed in the northeastern portion of the San Jose Hills, have been classified as MRZ-3.

WESTERN PUENTE HILLS

There are a few areas in the Western Puente Hills where Tertiary sedimentary formations that contain conglomerates and sandstones are exposed. These areas are potential sources of aggregate and have been classified as MRZ-3. These Tertiary sedimentary units are the Sycamore Canyon and the Soquel members of the Puente Formation, and the upper member of the Fernando Formation.

The Sycamore Canyon Member of the Puente Formation consists of fine- to coarse-grained sandstone, pebble conglomerate, and interbedded micaceous sandy siltstone. The conglomerate-sandstone-siltstone ratios vary considerably, depending on the specific locality. Consequently, each locality must be evaluated separately in order to determine its potential for aggregate use. Parts of the Sycamore Canyon Member are currently being mined in the adjacent Orange County-Temescal Valley P-C Region near Prado Dam.

The upper member of the Fernando Formation consists of massive sandstone, silty sandstone and pebble conglomerate, pebbly sandstone, and siltstone. Parts of this upper member are currently being mined in the Orange County-Temescal Valley P-C Region for base material in a quarry near Carbon Canyon.

Sediments belonging to the Soquel Member in the Western Puente Hills have similar lithologies to those sediments belonging to the same member in the San Jose Hills.

REPETTO HILLS

A few areas within the Repetto Hills believed to contain potential sources of aggregate are zoned MRZ-3. These are areas underlain by well-bedded, medium- to coarse-grained sandstones of the Puente Formation, conglomerates and sandstones of the Fernando Formation, and medium- to coarse-grained, well-bedded sandstones of the Topanga Formation.

MONTEBELLO HILLS

The Montebello Hills, situated on the southern flank of the Repetto Hills, are classified as MRZ-3. These hills are a geomorphic expression of an easterly-trending, elongated anticlinal fold. Pleistocene sands and conglomerates that overlap the upper member of the Pico Formation are exposed at the surface irregularly around the periphery of the hills. The upper member of the Pico Formation is exposed along the axis and the crest of the anticline. These rocks consist of massive buff siltstone containing several thin fossiliferous sandstone and conglomerate beds.

PALOS VERDES HILLS

The Palos Verdes Hills constitute an isolated upland peninsula along the southwest border of the Los Angeles Basin. These hills contain a number of formations which contain a variety of sedimentary rocks. Only a small portion of the hills are classified as having potential aggregate resources. Areas which are most likely to contain suitable material for aggregate use are those underlain by the San Pedro Sandstones (see page 5 for description). Outcrops of the San Pedro Sandstone indicate that most of the unit is homogeneous, yet the lack of test data, along with the lack of mining activities in much of the area underlain by the sandstone, prevents classifying the area as MRZ-2. Consequently, all areas underlain by the San Pedro Sandstone are classified as MRZ-3 except where mining has or is currently taking place.

In addition to the San Pedro Sandstone, several basalt bodies exposed in the Palos Verdes Hills may be potential crushed rock aggregate sources. Most of these igneous bodies are sills ranging in thickness from a foot to several hundred feet.

Areas Classified MRZ-4

Areas where available information is inadequate for any other classification have been assigned as MRZ-4 (Plate 4.1). Within the San Gabriel Valley P-C Region, the only areas so classified are limited to alluvial areas for which well-log data are lacking.

EVALUATION OF AGGREGATE RESOURCES IN THE SAN GABRIEL VALLEY P-C REGION

An analysis of aggregate supply in the San Gabriel Valley P-C Region is presented in this section of the report. The analysis was conducted on the basis of a quantitative evaluation of aggregate resources contained in urbanizing portions of the San Gabriel Valley P-C Region. Two similar evaluations have already been completed for the adjacent San Fernando Valley P-C Region (Anderson and others, 1979) and the Orange County-Temescal Valley P-C Region (Miller and others, 1981). A less detailed study has been made of the Claremont-Upland P-C Region, which borders the San Gabriel Valley P-C Region on the west (Plate 4.1). Evaluation of all adjacent P-C regions is necessary in order to determine what effects these regions might have on the availability of aggregate in the San Gabriel Valley P-C Region. These evaluations are presented in the "Alternative Sources of Aggregate" beginning on page 17.

A substantial amount of land in the San Gabriel Valley P-C Region has been classified MRZ-2 (Plate 4.1). By far, the bulk of the sand and gravel deposits contained within these classified areas occurs beneath urbanized land. Some of the remaining land is unoccupied, but is broken up into isolated properties by subdivisions, freeways, roads, power lines, and waterways. These unoccupied properties are, in many cases, too small to be considered for sand and gravel extraction.

Urbanized Versus Nonurbanized Land Uses

The State Geologist is responsible for calculating aggregate resources for those MRZ-2 areas that meet the State Mining and Geology Board's guidelines as candidates for designation by the Board. The Board has provided general criteria by which the State Geologist can make final decisions as to which portions or sectors of MRZ-2 areas would qualify as candidates for designation and has indicated its general intent by providing policy guidance to local governments concerning *compatible* and *incompatible* uses on lands adjacent to designated lands (California Division of Mines and Geology, 1979, p. 40). Because the Board does not designate areas presently dedicated to land uses that are incompatible with mining, the State Geologist has limited the calculation of aggregate resource tonnages to those MRZ-2 areas that have compatible land uses. Doing this has expedited the completion of the classification reports.

Because specific criteria to identify incompatible land uses are lacking, it is possible that more or less area than that identified by the State Geologist as *incompatible* will be judged by the Board to be *compatible,* based on further interpretations of these terms during their deliberations.

Because the Board's characterizations of *compatible* and *incompatible* provide only a general guidance rather than specific criteria for labeling particular MRZ-2 areas, the State Geologist has adopted the terms *nonurbanized* and *urbanized* for application to the particular MRZ-2 areas being considered, throughout this report.

Nonurbanized land includes very low density residential land (approximately one unit or less per ten acres), recreational land that does not have high cost improvements, agricultural land, silvicultural land, grazing land, and open space.

Urbanized land includes areas containing improvements of high cost, such as high density residential developments, intensive industrial developments, commercial developments, and major public facilities.

The determination of the above classifications for this report is based upon conditions of the land at the time of the study, in 1980. The use of the land was determined by the field geologists assigned to this project from information obtained through discussions with local agencies, examination of modern aerial photographs, and field reconnaissance observations.

Data Base

Much of the resource calculation that follows is based on an evaluation of drill-hole records of variable reliability collected over a time span extending back to the early part of this century. The drill-hole records describe the types of earth material (silt, sand, gravel, and bedrock types) encountered at various depths. The quality of drill-hole descriptions range from poor to very

od, but only drill-hole records that contain descriptions judged be acceptable for analysis were used in the present study.

Terminology used to reflect the confidence level of resources s been adopted from U.S. Geological Survey Bulletin 1450-A ppendix C in SR 143, Part I). For this study, permitted ources (reserves) fall under the category of indicated re-ves. Non-permitted resources meet the criteria set forth for th indicated and inferred resources.

Reserves and Resources

A mineral commodity is recoverable only if local regulations rmit mining activity. Therefore, sand and gravel resources rein placed in the category of *reserves* are limited to resources at underlie land where mining is permitted by lead agencies ving jurisdiction over such land. The term *resources* includes th *reserves* and *non-permitted resources* (usable materials hich could be mined in the future, but for which no use permit lowing extraction has been granted, or for which development is not been definitely established to be feasible based upon rrent technological or economic conditions).

Because almost all of the total reserves and resources for the n Gabriel Valley P-C Region lie within the San Gabriel allu-al fan, the following general discussion of evaluation parame-rs applies to aggregate deposits in the San Gabriel alluvial fan Sectors A-E). The parameters used in evaluating the aggregate eposits in the other resource sectors in the P-C region (Sectors -I) are explained in the individual sections dealing with those ectors.

ERMITTED RESOURCES (RESERVES)

Most reserve figures for the San Gabriel alluvial fan represent at portion of the resources underlying mining properties with use permit to mine to a maximum depth of 150 feet. The 50-foot depth limit is a regulatory constraint set by the City of windale (see "Regulatory Constraints," page 9). Three min-g operations, two in the City of Irwindale and the other in the ity of Azusa, are mining to depths in excess of 150 feet as uthorized by the terms of their conditional use permits.

ON-PERMITTED RESOURCES

Figure 4.6 shows the generalized thickness of sand and gravel the San Gabriel alluvial fan believed to be suitable for use as onstruction material. That portion of the suitable sand and ravel deposit whose extraction is not currently covered by a use ermit and which lies at a technologically feasible mining depth herein considered to be 400 feet maximum) is placed in the ategory of non-permitted resources. These resources may lie eneath land which is currently being mined or they may lie eneath unurbanized land which has no permit for extraction.

Mining Constraints

The quantity of reserves is highly dependent on both regula-ry and economic constraints. Non-permitted resources have no egulatory or economic constraints because there is no way of knowing what regulatory or technological changes may take place before these resources become available. Consequently, current constraints should be used only as a starting point and it should be noted that the quantity of non-permitted resources may be drastically decreased or increased depending on future constraints.

REGULATORY CONSTRAINTS

The major regulatory restrictions that affect the total sand and gravel reserve pertain to slope angle, depth of extraction, and setback requirements. These regulatory constraints are largely imposed by the city or county that has jurisdiction over the mining property, but state and federal government agencies may impose their own special regulations.

Most of the sand and gravel operations in the San Gabriel Valley P-C Region fall within the jurisdictional boundaries of the City of Irwindale. Any new sand and gravel extraction within Irwindale must be within a Q zone. Irwindale's Ordinance No. 245 addresses the permitted use for Q zones. The ordinance restricts the finished mining slopes to a maximum of one foot horizontally to one foot vertically (1:1) and permits mining to a maximum depth of 150 feet. Prior to Irwindale's adoption of the Q zones, mining was permitted on M-2 zoned properties under the regulations of a conditional use permit. These conditional use permits impose a 1:1 slope and a 150 foot depth limitation. Digging in excess of 150 feet in the Q zones and M-2 zones requires approval by the Irwindale City Council. The Livingston-Graham Company and the Conrock Company have recently been granted an exemption which permits both companies to mine to depths exceeding 150 feet.

Other cities that have jurisdiction over sand and gravel mining properties are Azusa, Pasadena, and Rolling Hills Estates. Rolling Hills Estates has also adopted a Q zone. Regulations for the Q zone are addressed in Ordinance Nos. 260 and 314 of the City of Rolling Hills Estates. Only one mining operation exists in the City of Rolling Hills Estates. Site-specific restrictions for this operation are stated in the Conditional Use Permit. Slope restrictions for this property are a maximum of 1:1 and minimum setbacks from property lines are 50 feet. There is no depth restriction stated in this permit. Mining depth is economically restricted by the depth of the water table which occurs at about 230 feet.

Azusa has not incorporated a Q zone into its city plans. Two active mining operations, Owl Rock and Transit Mixed Concrete, lie within the jurisdictional boundaries of Azusa. Regulations for these mines are set in Conditional Use Permits issued by the Azusa City Council. Slope restrictions are 1½:1 for the Owl Rock Mine and 1:1 for the Transit Mixed Concrete operation. Neither of these mines have any depth restrictions stated in their conditional use permits.

The only mining operation in the City of Pasadena is located in the Devils Gate Reservoir area, which is zoned R (residential). This land is owned by the City of Pasadena, which leases it to a private company for the purposes of mining. Because this land is owned by the City of Pasadena, it is exempt from any zoning regulations. The mine does not operate under any permit but instead is regulated by the Los Angeles County Flood Control District. The depth of excavation ranges from one foot to approximately 30 feet, depending upon the location in the wash. There are no setback regulations, but mining is restricted to the leased area.

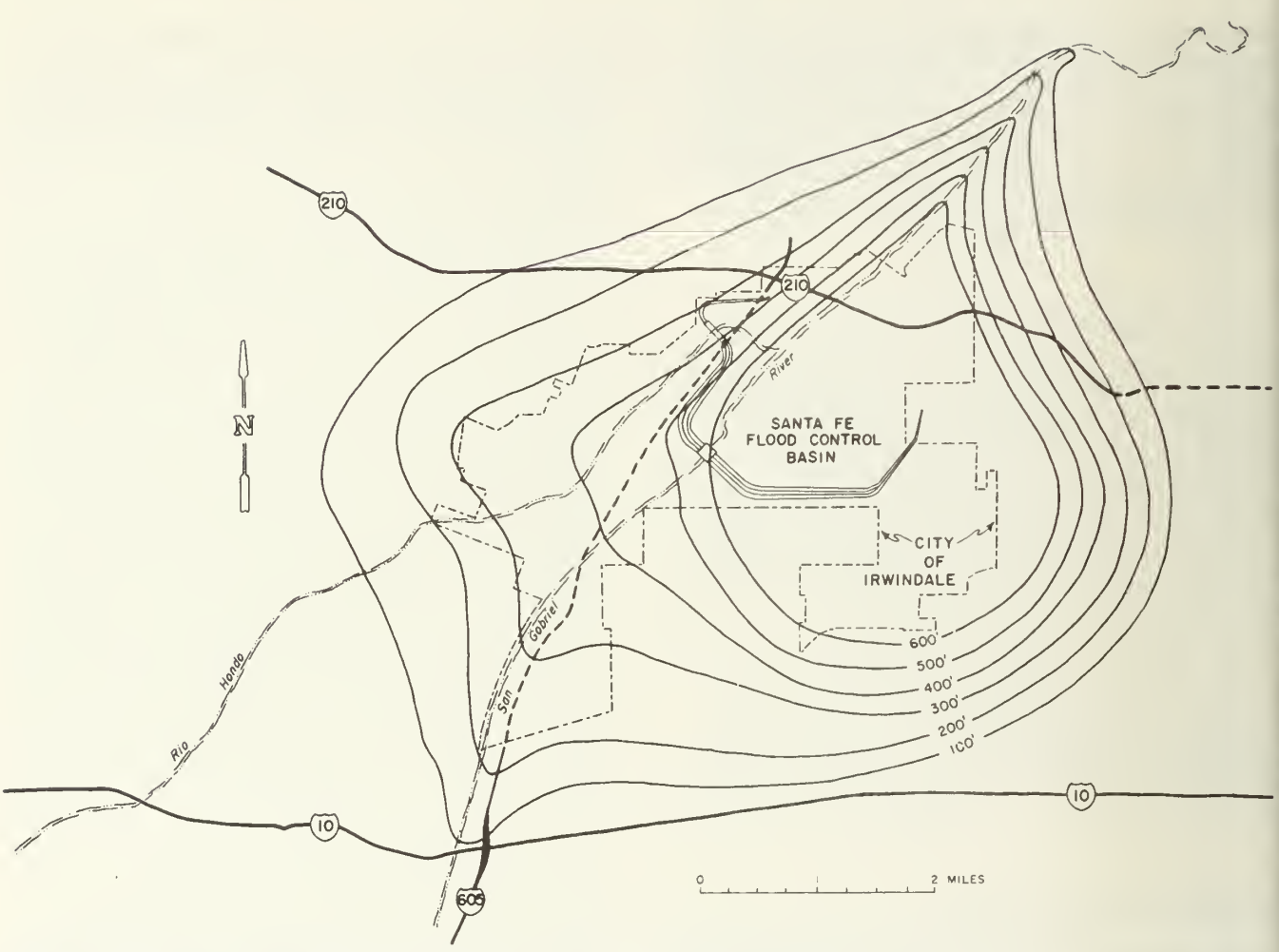


Figure 4.6 Contour map showing generol thickness of sand and grovel within the San Gobriel Volley fon production district.

ECONOMIC CONSTRAINTS

In classifying sand and gravel deposits as significant and in calculating the available resources and reserves within those deposits, the following conditions involving economic factors must be satisfied:

1. Material meets the *mineability* and *threshold* criteria given in the "Guidelines for Classification of Mineral Lands" (Appendix A-3 in SR 143, Part I)
2. The deposit consists of sound durable material substantially free of chemically reactive substances that would preclude its use as a construction material.
3. Combined clay and silt fraction does not exceed 25 percent by volume.

Resource Sectors

To organize the volume calculations of the aggregate resources, and to inform the Board about the resources within specific land-use areas, the State Geologist has utilized the concept of "sectors" to identify those MRZ-2 areas that meet the Board's guidelines as eligible to be designated of regional or statewide significance. Each sector shown on Plates 4.3 and 4.4 is a part of the nonurbanized MRZ-2 land where the geometrical configuration of the deposit is fairly uniform, so that tonnages of the available mineral resource can be estimated with some degree of reliability. Thus, for example, sector boundaries would be established between that part of a natural deposit formed on a fan, and that part within the confines of an adjacent modern stream channel and its floodplain. The sector concept is used for the convenience of arraying resource information and is not intended to imply any recommendation for designation or for designation priority.

All sand and gravel deposits suitable for aggregate in the nonurbanized part of the San Gabriel Valley P-C Region have been divided into nine sectors for the purpose of making resource calculations. Sectors A-E contain alluvial areas within the San Gabriel fan production district (Plate 4.3). Sectors F through H are wash areas that are fed by watershed in the San Gabriel Mountains. The nonurbanized portion of Eaton Wash comprises Sector F. Sector H lies within the Devils Gate reservoir area. Sector I encompasses a unique bedrock deposit which is in the north central portion of the Palos Verdes peninsula (Plate 4.4).

ECTORS A AND B - NORTHERN SAN GABRIEL WASH

Sectors A and B, which cover the upper reaches of the San abriel alluvial fan, encompass a 1,450-acre portion of nonur-anized land extending from the mouth region of the San Gabriel anyon southward along the San Gabriel River to the northern argin of the Santa Fe Flood Control Basin (Plate 4.3). For the urposes of this report, this area will be referred to as the North-rn San Gabriel Wash. The area measures about 2 miles in length nd 1,500 to 4,000 feet in width.

Sectors A and B are discussed jointly because they are both tuated in the same physiographic area. Sector B includes all onurbanized portions of the Northern San Gabriel Wash that re included as part of the Santa Fe Dam Recreation Area, while ector A comprises the remaining portion of the Northern San abriel Wash. Sector A has no known current or proposed land ses that may be incompatible with sand and gravel mining. A rther discussion of these sectors is presented below in the Land Use Considerations" section beginning on page 13.

Well-log evaluation indicates that the depth of sand and gravel eposits in Sectors A and B believed to be of suitable quality for se in Portland cement concrete aggregate is 30 feet at the mouth f the San Gabriel Canyon and over 600 feet at the most south-rly extent of the sectors. Technological constraints limit the epth for economic resource extraction to a maximum of 400 et for Sectors A and B as well as for Sectors C, D, and E. esource calculations reflect this depth. There is no overburden. one of the drill holes located between the mouth of the canyon nd the southern extent of the sector penetrated bedrock. Well-gs within a few hundred feet of the outer canyon walls bot-omed out in alluvium at a depth of about 150 feet. This indicates sharp bedrock relief in the subsurface. The depth to bedrock nd the surface bedrock configuration in Sectors A and B are not known. However, these factors do not appear to be critical in the present resource evaluation because well-log analysis shows that depth of resource is controlled by the presence of excessive silt and clay material in the substratum.

Based upon information provided by sand and gravel companies operating within the San Gabriel alluvial fan, the following assumptions were made for Sectors A and B, as well as C, D, and E.

1. The material is assumed to have an average waste of 10%.
2. The inplace density of the resource is assumed to be .065 short tons of sand and gravel per cubic foot (15.4 ft^3/ ton).
3. Pit-wall slopes will not exceed a 1:1 gradient. (This is the maximum final gradient which is authorized in the use permits issued to mining operations within the San Gabriel alluvial fan.)

There are 280 million tons of non-permitted resources included in Sector A. An additional 360 million tons of non-permitted resources are included in Sector B (Table 4.2). In order to protect proprietary information, reserve estimates for Sector A are not given in Table 4.2, but they are included in the total reserves for all sectors. There are no reserves in Sector B.

SECTOR C - SANTA FE FLOOD CONTROL BASIN AND SPILLWAY

Sector C encloses the area known as the Santa Fe Flood Control Basin and Spillway (Plate 4.3). As indicated on Figure

able 4.2 Aggregate resources of the San Gabriel Valley P-C Region (all numbers in million short tons).

SECTOR	RESOURCES	
	PERMITTED RESOURCES (RESERVES) (Indicated Category)	NON-PERMITTED RESOURCES (Indicated and Inferred Category)
A	*	280
B	none	360
C	none	1320
D	150	600
E	50	440
F	none	5**
H	*	35**
I	*	15
TOTAL	280	3060

Cannot be shown due to confidentiality of producer data
40% of this material is suitable for use in Portland cement concrete
OTE: All figures over 50 million rounded down to nearest 10 million. Figures less than 50 million rounded down to nearest five million tons.

4.6, sand and gravel believed to be of suitable quality for Portland cement concrete aggregate extends to a depth of about 600 feet over most of the area contained in Sector C.

A total of 1,320 million tons of non-permitted resources (0-400 foot depth) are contained in areas enclosed in Sector C. There are no reserves within Sector C.

SECTOR D - SAN GABRIEL ALLUVIAL FAN, WEST

Sector D consists of numerous isolated nonurbanized areas to the west and southwest of the Santa Fe Dam (Plate 4.3). Most of these areas are controlled by aggregate producers and are sites of present day or past mining activity. The depth of sand and gravel suitable for Portland cement concrete aggregate is less than 200 feet in the far western and southern portions of the sector and more than 600 feet in the northeastern areas (Figure 4.6).

Approximately 150 million tons of reserves remain in Sector D. An estimated 600 million tons of non-permitted resources are believed to lie beneath Sector D.

SECTOR E - SAN GABRIEL ALLUVIAL FAN, EAST

Sector E encloses several properties which lie to the east and southeast of the Santa Fe Flood Control Basin (Plate 4.3). Much of the resources underlying Sector E are controlled by aggregate producers. Subsurface data indicates that sand and gravel suitable for use in Portland cement concrete exceeds depths of 600 feet in all portions of Sector E.

An estimated 50 million tons of reserves remain in Sector E. Approximately 440 million tons of non-permitted resources lie beneath Sector E.

SECTOR F - EATON WASH

All resources underlying Sector F are located within the alluvial channel beneath Eaton Wash (Plate 4.4). Resource estimates for material underlying this sector were determined for the major nonurbanized portion of the wash which is north of Sierra Madre Boulevard. Approximately 35% of the material within the wash consists of coarse material. The remaining 65% is fine sands, silts, and clays. Well-logs indicate that the material has less silts and clays at the northern end of the wash than at the southern end. Consequently, the waste percentage increases to the south. Asphaltic sand and gravel and concrete sand have been produced from Eaton Wash deposit, but there is currently no mining taking place within the wash. Excavation of material within the wash for channel maintenance does take place after heavy rainfall periods.

Sector F includes all of the nonurbanized land within the wash north of Eaton Wash Dam. An average of 50 feet of sand and gravel lies beneath Sector F. Overburden averages approximately 3 feet.

Based upon field observations and information provided by a sand and gravel company which previously mined material from Eaton Wash, the following assumptions were made for determining the resource for Sector F.

1. The material is assumed to have an average waste of 30%.
2. Approximately 40% of the resource is suitable for use as Portland cement concrete aggregate.
3. The inplace density of the resource is assumed to be .065 short tons of sand and gravel per cubic foot (15.4 $ft.^3$/ton).
4. The pit wall slopes will not exceed a 1:1 finished gradient.

Based on the above assumptions, approximately 5 million tons of non-permitted resources are believed to underlie Sector F. Of this total resource, approximately 2 million tons of aggregate (40% of the resource) is believed to be suitable for Portland cement concrete aggregate.

The portion of Eaton Wash identified as Sector G in preliminary drafts of this report has been deleted.

SECTOR H - DEVILS GATE RESERVOIR

Sector H is a 200-acre wash area within Arroyo Seco to the north of Devils Gate Dam. This area is referred to as the Devils Gate Reservoir Area (Plate 4.4). One aggregate company is currently mining Portland cement concrete aggregate within this sector. A major function of this operation is to provide channel maintenance for the Los Angeles County Flood Control District.

Drill holes in this sector indicate a depth of sand and gravel to 100 feet below the present day channel surface. There is no overburden. The overall mining depth for the current operation is controlled by the Los Angeles County Flood Control District under the current excavation plan. In most areas, the excavation depth does not exceed 30 feet. Since there is little information regarding the quality of material below 30 feet, this depth was used for resource calculations.

Based upon both field observations and information provided by the sand and gravel company operating within the Devils Gate Reservoir Area, the following assumptions were made for determining a resource for Sector H.

1. The material is assumed to have an average waste of 30%.
2. Approximately 40% of the resource is suitable for Portland cement concrete aggregate.
3. The inplace density of the resource is assumed to be .065 short tons of sand and gravel per cubic foot (15.4 $ft.^3$/ton).
4. The pit-wall slopes will not exceed a 1:1 gradient (although this slope may be regulated by the L.A. County Flood Control District).

Based upon the above assumptions, approximately 35 million tons of non-permitted resources are believed to lie beneath Sector H. Of this 35 million tons, approximately 14 million tons of material (40% of the total resource) is believed to be suitable for use as Portland cement concrete aggregate. The reserves for Sector H are proprietary, but are included in the total reserves for all sectors in Table 4.2

SECTOR I - PALOS VERDES HILLS

Sector I covers approximately 120 acres located in the northeastern flank of the Palos Verdes Hills (Plate 4.4). Aggregate in Sector I is produced from the San Pedro Sandstone. This deposit is the only bedrock deposit that is being mined for aggre-

e in the San Gabriel Valley P-C Region. Because the consists almost solely of sandstone, and because Portland concrete requires an almost equal mixture of sand and this deposit cannot be classified as an independent source gate for making Portland cement concrete. Nevertheless, des the only local source of Portland cement concrete the Palos Verdes area. Other aggregate products pro- from this deposit include plaster sand, masonary sand, nite sand.

-hole data in Sector I shows that the sandstone extends hs of nearly 600 feet. Presently, no depth regulations are for the operation. The main economic depth constraint epth to the water table, which is approximately 230 feet mean sea level. Also, mining depth is restricted to the t which the pit walls nearly converge.

d upon both field observations and information provided sand and gravel company operating within Sector I, the ng assumptions were made for determining a resource for I.

here is an overall uniformity and continuity of the San edro Sandstone in the area shown as Sector I (Plate 4.4).

he material has an average waste of 7%.

he inplace density of the resource is assumed to be 0.57 ns per cubic foot (or 17.5 ft. ^{3}/ton).

he maximum extent of mining is the depth at which the t walls nearly converge.

he pit walls will not exceed a 1:1 final gradient.

d upon the above assumptions, approximately 15 million non-permitted resources underlie Sector I. Reserve esti- are confidential.

Land Use Considerations

resource estimates that have been made for Sectors A-I e the total quantity of aggregate material that is geologi- vailable for mining. As previously explained, areas already zed were excluded from resource calculations. Otherwise, ource estimates for Sectors A-I do not reflect land-use erations. The estimates include resources in areas current- mitted to a particular land use. A prime example is the Fe Dam Recreational Area, a federally owned regional veloped by the Los Angeles County Department of Parks ecreation. The park area includes more than 1,100 acres located in the Santa Fe Dam reservoir and spillway area, e upper reaches of the San Gabriel River. Land belonging recreation area that contains sand and gravel resources n grouped into Sectors B and C (Plate 4.3). It is estimat- t these two sectors alone contain approximately 1,680 tons of resources, which is more than half of the total illion tons of resources present in the San Gabriel Valley egion.

r areas which are known to have a specified use other nd and gravel extraction, are parcels of land currently by the Miller Brewing Company and the Conrock Com- These parcels are located within Sector E, adjacent to the boundary of the Santa Fe Dam Recreation area. An estimated 100 million tons of resources (or about ¼ of the total resources in Sector E) are contained beneath these areas.

ESTIMATED 50-YEAR CONSUMPTION OF AGGREGATE

The total projected consumption of aggregate in the San Gabriel Valley P-C Region for the next 50 years is estimated to be 780 million tons (Table 4.3). This estimate is based on past consumption-rate patterns as described in SR 143, Part I, "Description of the Mineral Land Classification Project of the Greater Los Angeles Area."

Aggregate Production Records

Aggregate production records were compiled for the years 1961 through 1977 for the San Gabriel Valley and its adjacent P-C regions (Figures 4.7- 4.10). Records for the greater Los Angeles Basin for the years prior to 1961 are, in most cases, incomplete. Aggregate production data were obtained from the United States Bureau of Mines (USBM) statistics. These records are compiled from responses to a voluntary questionnaire that is sent out on an annual basis to all known mining operations. Each producer is requested to divulge their annual production for the preceeding year. It is important to note that the degree of accuracy of these statistics depends strictly on the producer's response. The CDMG staff had no way of checking incorrect information or getting production data from companies who did not respond to the U.S. Bureau of Mines inquiries.

Population Records

Population data for the San Gabriel Valley and its adjacent P-C regions were also compiled for the years 1961-1977 (Figures 4.7- 4.10). The historical population data for this period was obtained from statistical bulletins that have been published by Los Angeles and Orange counties on a quarterly or annual basis.

Population projections for the years between 1978 and 2020 were made for the P-C region using area projections furnished by county governments, the State Department of Finance (1977), and the Southern California Association of Governments (1978). Population projections for the 10-year period between 2020 and 2030 were extrapolated by CDMG staff from the above mentioned data. The resulting population projections to the year 2030 are presented on Figure 4.11.

Per Capita Consumption Rates and Population Densities

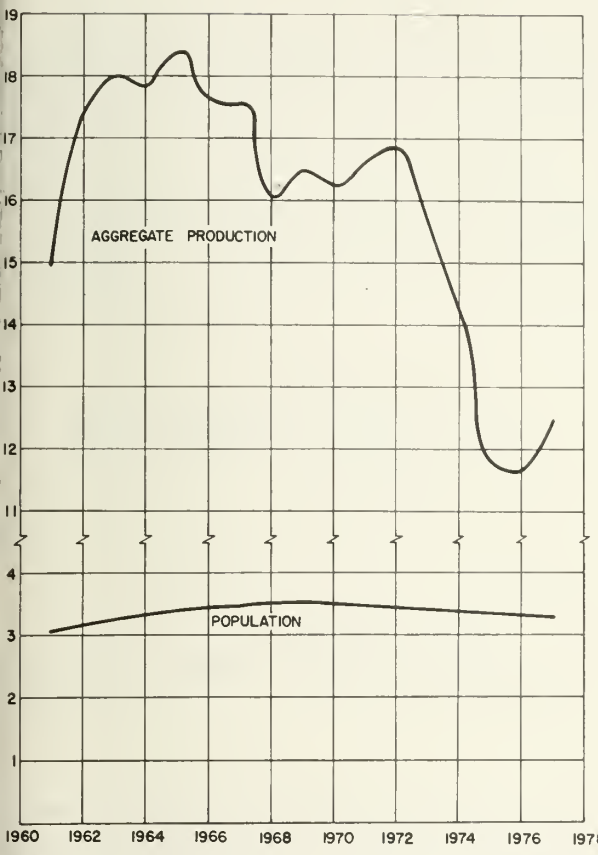
Per capita consumption rates of aggregate have varied through time and are different in each P-C region. Several factors, such as changes in urban growth with time, relative degrees of urban maturity, and proximity to major construction projects (for example, freeways), account for some of the variations and differences.

Historical per capita consumption rates from the years 1961 through 1977 for the San Gabriel Valley and its adjacent P-C regions are shown on Figure 4.12. The San Gabriel Valley P-C Region had an average consumption rate of about 4.5 tons of

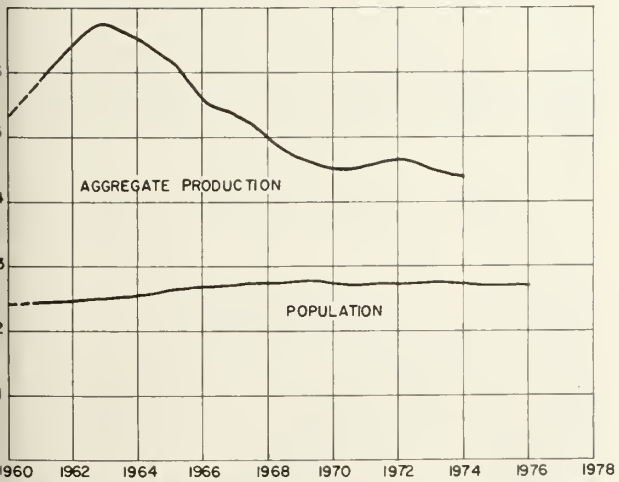
Table 4.3 Projected aggregate consumption(to the year 2030)for the San Gabriel Valley, San Fernando Valley, Orange County-Temescal Valley and Claremont -Upland P-C regions

YEARS	SAN GABRIEL VALLEY P-C REGION			SAN FERNANDO VALLEY P-C REGION			ORANGE CO-TEMESCAL VALLEY P-C REGION			CLAREMONT-UPLAND P-C REGION		
	Average Population (millions)	5 year Per Capita Consumption (tons)	Aggregate Consumption (million tons)	Average Population (millions)	5 year Per Capita Consumption (tons)	Aggregate Consumption (million tons)	Average Population (millions)	5 year Per Capita Consumption (tons)	Aggregate Consumption (million tons)	Average Population (millions)	5 year Per Capita Consumption (tons)	Aggregate Consumption (million tons)
1980-1985	3.68	X 21.4	= 79	2.74	X 8.0	= 22	2.46	X 28.9	= 71	.54	X 43.7	= 24
1985-1990	3.74	X 21.1	= 79	2.80	X 8.0	= 22	2.73	X 27.8	= 76	.57	X 43.7	= 25
1990-1995	3.82	X 20.8	= 79	2.86	X 8.0	= 23	2.97	X 26.9	= 80	.59	X 43.7	= 26
1995-2000	3.87	X 20.3	= 79	2.91	X 8.0	= 23	3.17	X 26.2	= 83	.61	X 43.7	= 27
2000-2005	3.92	X 20.0	= 78	2.95	X 8.0	= 24	3.34	X 25.5	= 85	.63	X 43.7	= 28
2005-2010	3.96	X 19.8	= 78	2.97	X 8.0	= 24	3.51	X 24.8	= 87	.64	X 43.7	= 28
2010-2015	4.01	X 19.5	= 78	2.99	X 8.0	= 24	3.67	X 24.3	= 89	.66	X 43.7	= 29
2015-2020	4.05	X 19.3	= 78	3.01	X 8.0	= 24	3.82	X 23.6	= 90	.67	X 43.7	= 29
2025-2025	4.09	X 19.0	= 78	3.03	X 8.0	= 24	3.95	X 23.3	= 92	.68	X 43.7	= 30
2025-2030	4.13	X 18.7	= 77	3.05	X 8.0	= 24	4.07	X 22.8	= 93	.69	X 43.7	= 30
TOTAL			780*			230*			850*			280*

* Figure rounded off to the nearest ten million tons.



ure 4.7 Son Gabriel Volley P-C Region: populotion ond oggregote pro-tion record for yeors 1961-1977.



ure 4.8 Son Fernondo Volley P-C Region: populotion ond oggregote pro-tion record for yeors 1961-1976.

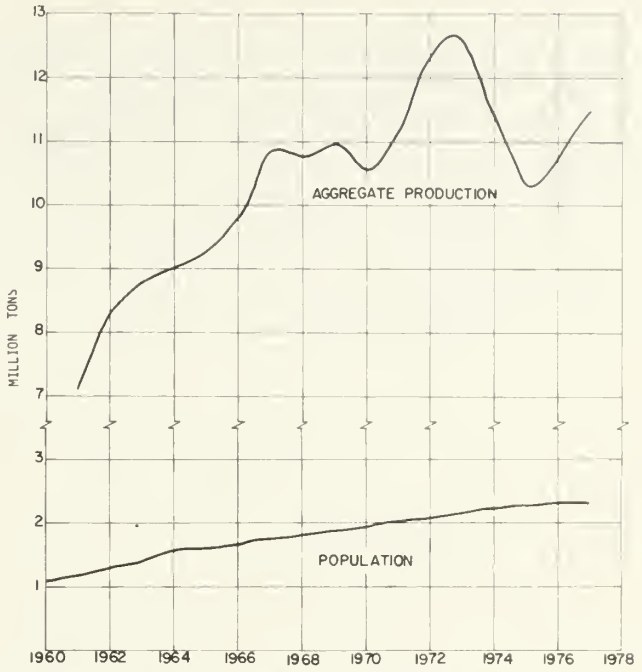


Figure 4.9 Oronge County-Temescol Volley P-C Region: populotion ond oggregote production record for yeors 1960-1977.

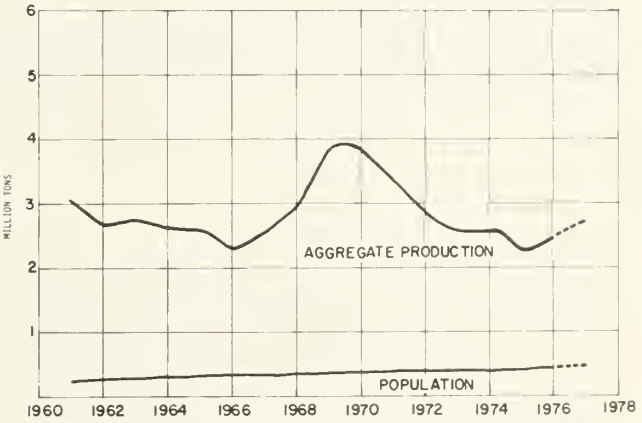


Figure 4.10 Cloremont-Uplond P-C Region: populotion ond oggregote production record for yeors 1961-1977.

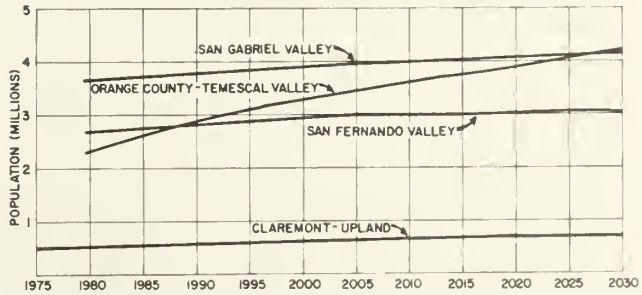

POPULATION (MILLIONS)
SAN GABRIEL VALLEY
ORANGE COUNTY-TEMESCAL VALLEY
SAN FERNANDO VALLEY
CLAREMONT-UPLAND
1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030

Figure 4.11 Projected populotion of the Son Gabriel Volley, Son Fernondo Volley, Oronge County-Temescol Volley, ond Cloremont-Uplond P-C regions to the yeor 2030.

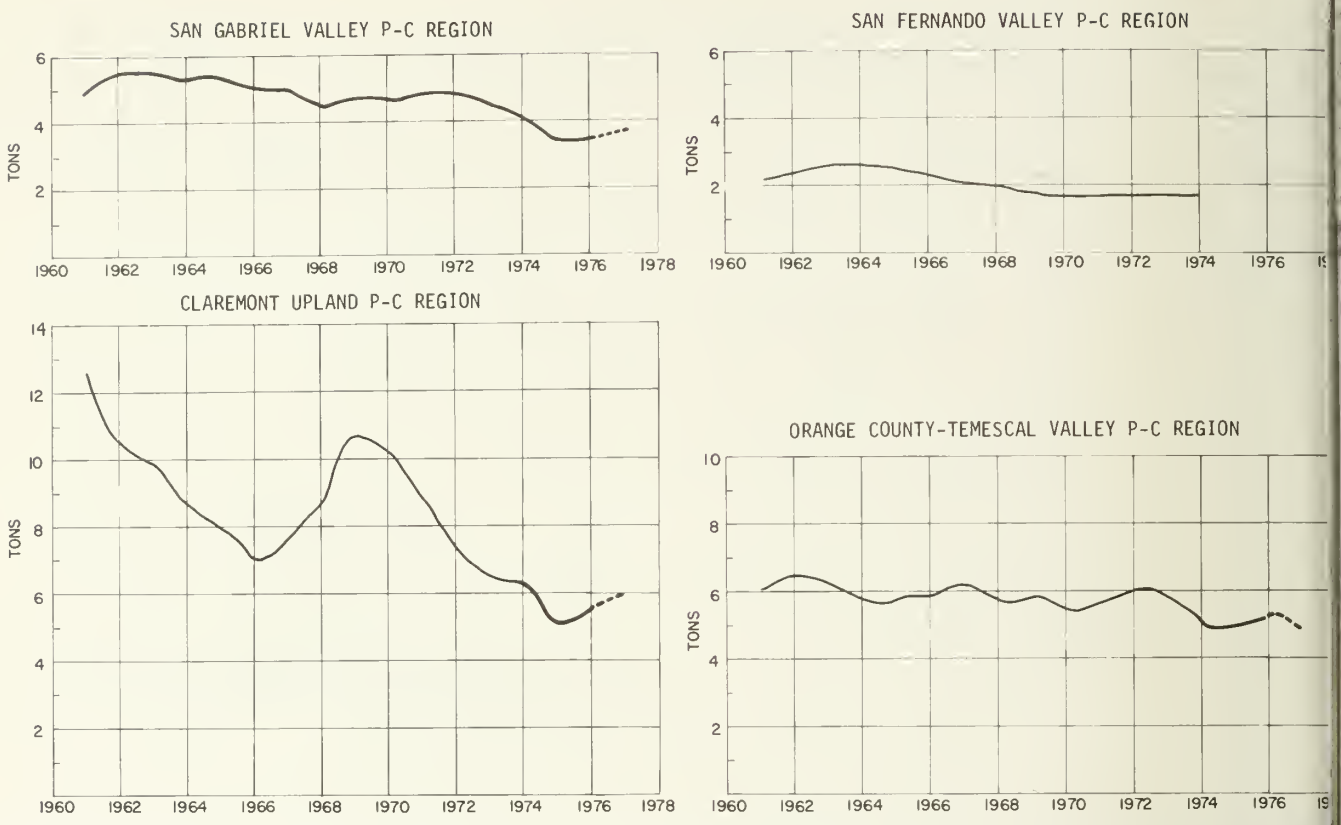


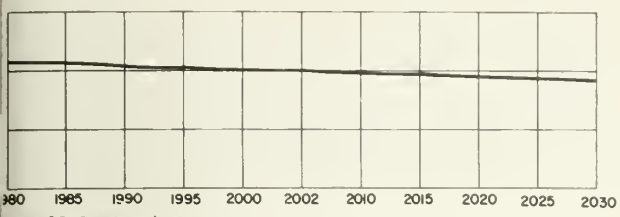
Figure 4.12 Annual per capita consumption of aggregate in the San Gabriel Valley, San Fernando Valley, Orange County-Temescal Valley, and Claremont-Upland P-C regions for years 1961-1977 (San Fernando Valley P-C Region data to 1974 only).

aggregate per person per year between 1960 and 1977 (Figure 4.12). In order to project the per capita consumption rate to the year 2030, per capita consumption data was plotted against population figures for the four large-population P-C regions in the greater Los Angeles area: San Fernando Valley, San Gabriel Valley, Orange County-Temescal Valley, and San Bernardino. Together these four regions total more than 90% of the population within the greater Los Angeles area. The resulting line indicated a gradual decline in the per capita consumption rate with increased population density. This consumption-rate trend was adjusted for in calculating the estimated aggregate consumption needs for the San Gabriel P-C Region to the year 2030 (Figure 4.13), based upon projected population increases for the period. The estimate for Orange County-Temescal Valley P-C Region is taken from Special Report 143, Part III. Similar estimates, without the calculated rate of per capita consumption decline, were made for the San Fernando Valley and Claremont-Upland P-C regions.

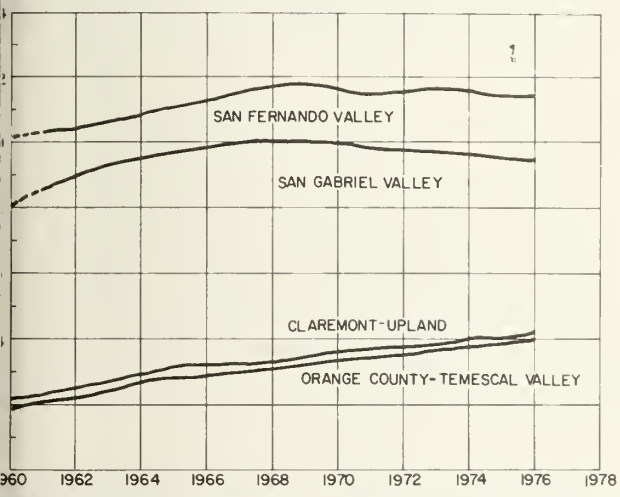
The population density of the San Gabriel Valley P-C Region appears to be moderately high in comparison to the less mature urban areas in the Claremont-Upland and Orange County-Temescal Valley P-C regions, yet it is somewhat lower than the more mature[1] San Fernando Valley P-C Region (Figure 4.14). This is reflected somewhat in the average per capita consumption rates established for these areas from 1960 to 1977. The San Gabriel Valley P-C Region's per capita consumption rate of 4.5 tons is lower than the Orange County-Temescal Valley rate of 5.9 and is substantially lower than the Claremont-Upland rate of 8.75. These higher rates may reflect the lower population densities[2] in the two P-C regions. The San Fernando Valley per capita consumption rate of 1.6 tons per year is substantially lower than the San Gabriel Valley's rate of 4.5. Again, this difference in rates is reflected in the population densities.

The San Gabriel Valley P-C Region's per capita consumption is not projected to change significantly in future years. This can be seen on Table 4.3, which shows less than a 10 percent decline in per capita rate in the next 50 years. Events such as massive urban renewal or disaster reconstruction would result in a sharp increase in per capita consumption of aggregate during the period of active reconstruction. The amount of aggregate needed in addition to the projected consumptions would depend upon the extent and duration of reconstruction. Per capita consumption would probably then gradually return to a maintenance level equivalent to that which existed before reconstruction began.

1. Full "urban maturity" is the point in the development of an area at which construction materials are used primarily to maintain what has already been developed rather than supply further development.
2. In P-C regions with relatively low population densities, a special project such as the construction of a freeway could cause a large per capita increase.



ure 4.13 Projected 50-year per capita consumption for the San Gabriel ley P-C Regian.



ure 4.14 Camparisan af papulatian densities far San Gabriel Valley, San nanda Valley, Orange Caunty-Temescal Valley, and Claremant-Upland regians far years 1960-1976.

ALTERNATIVE SOURCES OF AGGREGATE

Potential alternatives to those sources of aggregate described Sectors A-I (Plates 4.3 and 4.4) occur in areas within and near San Gabriel Valley P-C Region. These sources include re-ırces in adjacent P-C regions, areas underlain by crystalline k, older Tertiary sedimentary deposits, other Holocene allu-l deposits, and offshore sediments.

Except for the resources in adjacent P-C regions, too little is own about the physical and chemical characteristics (see verview of Aggregate," SR 143, Part I) of alternative sources aggregate to permit resources estimates. However, a general cussion about the potential resources, their occurrence, and tors controlling their utilization is presented in the following tion.

Sand and Gravel Resources of Adjacent P-C Regions

SOURCE ESTIMATES

Resource estimates for two of the adjacent P-C regions, San rnando Valley and Orange County-Temescal Valley, have al-ady been completed (Anderson and others, 1979; Miller and ers, 1981). Resource calculations for the remaining adjacent P-C region, Claremont-Upland, represents modifications of data taken from California Division of Mines and Geology Special Report 139 (Evans, 1979) and are preliminary. Mineral Resource classification is also preliminary in this P-C region. The *reserve* estimates are current to January 1979. The *resource* estimates were made relying upon published geologic maps with additional reconnaissance field checking, including visits to sand and gravel plants operating in 1978. The following values and conditions were assumed in estimating the largest part of the Claremont-Upland resources:

(1) Material density ranges from .060 to .065 short tons per cubic foot.

(2) Waste material does not exceed 25 percent.

(3) Present technology allows economic extraction to the depths calculated.

(4) Estimates were limited to areas which are not urbanized and for which mining is still a possible land use.

The estimated resources of the adjacent P-C regions are summarized in Table 4.4.

ESTIMATED 50-YEAR CONSUMPTION OF AGGREGATE IN ADJACENT P-C REGIONS

The estimated 50-year aggregate needs for adjacent P-C regions are presented on Table 4.3. Comparison of Table 4.3 and 4.4 shows that the projected 50-year total consumption of aggregate for each of the three adjacent P-C regions is less than their respective total *resource* estimates. However, the *reserves* in the San Fernando Valley, the Orange County-Temescal Valley, and the Claremont-Upland P-C regions are not sufficient to supply their respective 50-year projected needs. This could mean a total shortfall of over one billion tons for these P-C regions. It should be noted then, if *non-permitted resources* within these three P-C regions are not utilized to fill the shortfall, they will have to be filled from other areas. In such an event, it is likely that a major source of supply would be reserves of the San Gabriel Valley P-C Region.

Crushed Rock Sources as Alternative

Metamorphic, granitic, and volcanic rocks may provide an alternative source of crushed aggregate for the San Gabriel Valley P-C Region (Figure 4.5). Most of these rocks lie within the unclassified area of the San Gabriel Mountains to the north of the P-C region. The prospective crushed rock resource areas that are located within the San Gabriel Valley P-C Region are zoned MRZ-3.

METAMORPHIC AND GRANITIC ROCKS

Metamorphic and granitic basement rocks of the San Gabriel and Verdugo Mountains, the San Rafael Hills, and eastern Santa Monica Mountains may provide an alternative source of construction-grade sand and gravel (Figure 4.5). Most of this exposed basement rock occurs outside of the San Gabriel Valley P-C Region, but is within close enough proximity to be considered as an alternative source of aggregate. Almost all of the sand and gravel within MRZ-2 areas of the San Gabriel alluvial fan, Eaton Wash, and Arroyo Seco was derived from this basement

Table 4.4 Aggregate resources of the San Fernando Valley, Claremont Upland, and Orange County-Temescal Valley P-C Regior

PRODUCTION-CONSUMPTION REGION	INFERRED RESERVES (Million Tons)	INFERRED RESOURCES (Million Tons)	TOTAL (Million Tons)
SAN FERNANDO VALLEY	40	720	760
CLAREMONT-UPLAND	40	1300	1350
ORANGE COUNTY-TEMESCAL VALLEY	260	1200	1460
CATEGORY TOTAL	340	3200*	3500*
TOTAL RESERVES-RESOURCES, San Fernando Valley, Claremont-Upland and Orange County-Temescal Valley:			

* Figures rounded down to nearest 100 million.

terrain. Therefore, it is likely that a large portion of these basement rocks are suitable for Portland cement concrete aggregate. Nevertheless, exploration, including detailed field mapping and testing, is necessary to delineate areas where basement rocks of suitable quality occur. Quality specifications of these rocks are discussed by Anderson and others, 1979, (p. 28).

TERTIARY VOLCANIC ROCKS

Tertiary volcanic rocks are exposed along several areas adjacent to and within the San Gabriel Valley P-C Region. These areas include the eastern Santa Monica Mountains, the northeastern San Jose Hills, the Glendora South Hills, and the southern front of the San Gabriel Mountains foothills near the City of Glendora (Figure 4.5). Some of these volcanic rocks are crystalline lava basalts which may prove to be processable into aggregate material, but these have not yet been tested for aggregate suitability. An additional discussion of Tertiary volcanic rocks is contained in a report by Anderson and others (1979, p. 29).

Tertiary Sedimentary Rocks as Alternative

Tertiary sedimentary rocks that may have potential for aggregate use include sandstones and conglomerates from the Topanga Formation, the Soquel and Sycamore Canyon Members of the Puente Formation, the lower member of the Fernando Formation (Repetto Formation), and the upper member of the Fernando Formation (Pico Formation) (Figure 4.5). A discussion of all of these formations is given in the "Areas Classified MRZ-3" section (p. 7) of this report. Mining in the Sycamore Canyon Member of the Puente Formation and the upper member of the Fernando Formation is currently taking place within the adjacent Orange County-Temescal Valley P-C Region (Miller and others, 1981). Mining of the Soquel Member of the Puente Formation has formerly taken place within the Orange Count Temescal Valley P-C Region. Although the quality of the Tertiary rocks has not been thoroughly evaluated, producti from these deposits often is of lower quality aggregate, which predominately used for base, fill, and asphaltic concrete.

Holocene Alluvial Deposits as Alternative

Approximately 1,400 acres of nonurbanized land lying behi the Whittier Narrows Dam may be a potential alternative r source (Plate 4.11, El Monte quadrangle). Extensive well-l data in the area shows sand and gravel exceeding depths of ov 500 feet, yet the quality of the material is unknown. Conseque ly, the Whittier Narrows area is classified MRZ-3. If the mater is found to be of suitable quality, the most limiting geolog factor will undoubtedly be the depth of ground water in the are The ground-water elevation at the Whittier Narrows area usually just a few feet below surface elevation. Even duri drought periods, the ground-water elevation has not fallen belc 15 feet below surface elevation.

Offshore Sediment Deposits as Alternative

Sand and gravel has been successfully mined for several yea from marine sources, notably offshore from the United Kin dom, Holland, the Virgin Islands, and the Bahama Islands. Tv potential offshore localities that are adjacent to the San Gabri Valley P-C Region (Plate 4.1) have been identified in the S Pedro area. Other offshore sand and gravel localities have be identified within the Santa Monica Bay adjacent to the S Fernando Valley P-C Region (Anderson and others, 1979, 31), and the San Clemente area adjacent to the Orange Count

mescal Valley P-C Region (Miller and others, 1981, p. 17). cial Report 143, Part II (page 31) discusses some of the sibility factors of mining offshore aggregate. The environmen- factors concerning damage to marine life might be some of most difficult to overcome. Nevertheless, because the tech- ogy for extraction of offshore deposits is available, they are ential alternative sources of aggregate.

Several deposits of aggregate are also known to occur in the ur-shore environment at shallow depths adjacent to Santa talina, San Clemente, and Santa Barbara Islands. Neither the antity nor quality of these deposits has been assessed.

CONCLUSIONS

Over 3 billion tons of aggregate *resources* are believed to exist the San Gabriel Valley P-C Region. However, current *reserves* ich are available within the San Gabriel Valley P-C Region not adequate for supplying construction aggregate for the -year projected population of over 4 million inhabitants. Based a projected population increase for the region (Table 4.3) and projected per capita consumption for each five-year period, proximately 780 million tons of aggregate will be required to isfy demand to the year 2030. Only 280 million tons of aggre- te *reserves* remain within the San Gabriel Valley P-C Region able 4.2), an amount which is projected to be depleted in proximately 18 years. The 500 million ton deficit can be sup- ed by (1) extending the operating life of existing operations ere there are *resources* available beneath the permitted depth mining; (2) opening new operations; and/or (3) importing terial from adjacent areas. All of these alternative actions ve potential economic and environmental drawbacks.

To extend the life of existing aggregate operations (if that is desired) would necessitate extracting material from greater depths than is currently permitted. This would require a careful assessment of the environmental consequences of excavating sand and gravel to greater depths.

The *reserve* figures for the adjacent P-C regions (Table 4.4) indicate that, like the San Gabriel Valley, none of these P-C regions have an adequate supply of *reserves* to meet their respective total projected needs to the year 2030 (Table 4.3). In fact, these data indicate that two of the adjacent P-C regions (the San Fernando Valley and the Upland-Claremont P-C regions) will exhaust their *reserves* before the San Gabriel Valley does. Consequently, it is likely that these adjacent P-C regions will need to import material from the San Gabriel Valley P-C Region, in which case its 18-year supply of reserves will be prematurely depleted. In the event of massive reconstruction following a catastrophic earthquake, the San Gabriel Valley P-C Region as well as the adjacent P-C regions could experience a shortage of aggregate within the next 10 years.

SUMMARY OF DESIGNATION FACTORS

Table 4.5 shows the eight aggregate resource sectors listed from top to bottom in order of their importance to the San Gabriel Valley P-C Region over the next 50 years as determined by the amount of aggregate resource contained within each sector and the ease with which that resource can be made available to the market. The latter depends on such factors as whether or not the resource is already permitted for extraction, its proximity to a market area, and whether or not there are any land-use conflicts.

ble 4.5 Summary of Designation Factors for the Resource Sectors in the San Gabriel Valley P-C Region.

Sectors	Percent of the total P-C region reserves within the sectors	Percent of the total P-C region non-permitted resources within the sectors	Active mining within sector	Remarks
A,D,E	>98	43	YES	Almost all land owned or leased by aggregate producers
B,C	NONE	55	NO	All land located within the Santa Fe Dam Recreational area
I	*	<1	YES	One active mine Local source Sand mining only
H	*	1	YES	One active mine Channel maintenance
F	NONE	<1	NO	Some channel maintenance

annot be shown due to confidentiality of producer data.

The most significant sectors within the San Gabriel Valley P-C Region are Sectors A, D, and E. They contain over 98% of the *reserves* and over 40% of the non-permitted *resources* in the region. The total *resources* contained within these sectors add up to over 1,300 million tons, which is more than adequate to supply the San Gabriel Valley P-C Region's 50-year demand of 780 million tons. These resources lie between 0-400 feet depths. The actual tonnage of material which will be extracted from Sectors A, D, and E depends on future land uses and permitted depths of mining.

Sectors B and C are also significant *resource* sectors in terms of tonnage of contained aggregate material. These two sectors have no *reserves,* but they do contain almost 1,700 million tons of non-permitted *resources,* which makes up over 50% of the total resources within the San Gabriel Valley P-C Region.

Sector I has less than 1% of the total non-permitted *resources* for the San Gabriel Valley P-C Region, yet it is a significant resource area because it provides a local source of sand to the Palos Verdes Hills and vicinity.

Sector H has approximately 1% of the total non-permitted *resources.* It is occupied by one producer. Besides supplying aggregate, mining within sector H also provides channel main nance.

Sector F, which contains less than 1% of all non-permitt resources and no reserves, is the least significant sector witl the San Gabriel Valley P-C Region. There is currently no mini taking place within this sector. Occasionally, flood debris excavated from Sector F in the main channel above Eaton Da

ACKNOWLEDGMENTS

The California Division of Mines and Geology gratefully knowledges the full cooperation of local government agenci organizations, and aggregate producers called upon for inforn tion during the course of this study. Special thanks are extenc to the Southern California Rock Producers Association; the I Angeles County Flood Control District; the planning depa ments of Los Angeles County and the cities of Irwindale, Azu Monrovia, Rolling Hills Estates, and Arcadia; the Southern C ifornia Association of Governments; and the California Depa ment of Water Resources.

REFERENCES - PART IV

Andersan, T.P., Loyd, R.C., Clark, W.B., Miller, R.V., Carbaley, R., Kohler, S., and Bushnell, M., 1979, Mineral land classificatian af the greater Los Angeles area; Descriptian of the mineral land classificatian praject af the greater Los Angeles area: Division of Mines and Gealogy Special Repart 143, Part I, 51 p.

Andersan, T.P., Layd, R.C., Clark, W.B., Miller, R.V., Carbaley, R., Kohler, S., and Bushnell, M., 1979, Mineral land classificatian af the greater Los Angeles area; Part I, Description of the mineral land classification praject of the greater Las Angeles area; Part II, Classificatian af sand and gravel resaurce areas, San Fernando Valley Production-Cansumption Region, Divisian af Mines and Geology Special Repart 143, Parts I and II, 79 p.

Califarnia Department af Transpartatian, 1975, Standard specificatians, 620 p.

Califarnia Department af Water Resources, 1934, Geology and graund water starage capacity af valley fill: Bulletin no. 45.

Califarnia Department af Water Resources, 1966, Planned utilizatian af graund water basins, San Gabriel Valley: Bulletin na. 104-2.

Califarnia Divisian af Mines and Gealogy, 1979, California surface mining and reclamation palicies and procedures: Special Publication 51, 40 p.

Durham, D.L., and Yerkes, R.F., 1964, Geology and ail resaurces af the eastern Puente Hills area, sauthern Califarnia: U.S. Gealagical Survey Prafessional Paper 420-B, map scale 1:24,000, 62 p.

Evans, J.R., Andersan, T.P., Mansan, M.W., Maud, R.L., Clark, W.B., and Fife, D.L., 1979, Aggregates in the greater Las Angeles area, Califarnia: Califarnia Divisian af Mines and Gealagy Special Repart 139, 96 p.

Gay, T.E., Jr., and Haffman, S.R., 1954, Mines and Mineral Depasits of Las Angeles Caunty, Califarnia, Califarnia Jaurnal af Mines and Gealogy, Califarnia Division af Mines, v. 50, na. 3 and 4, p. 467-607.

Jennings, C.W., and Strand, R.G., 1969, Geologic Map af Califarnia, Las Angeles sheet: Califarnia Divisian af Mines and Gealagy, scale 1:250,-000.

Kundert, C.J., 1952, Gealagy af the Whittier-La Habra area: Califarnia Divisian af Mines and Gealagy Special Repart 18, 21 p.

Lamar, D.L., 1970, Gealagy af the Elysian Park-Repetta Hills Area, Las Angeles County, Califarnia: California Divisian af Mines and Gealagy Special Repart 101, 45 p.

Lackman and Assaciates, 1975, City af Irwindale quarry rehabilitatian plan, phase I basis far planning: Unpublished cansultant repart, 23 p.

Lackman and Assaciates, 1976, Draft City of Irwindale quarry rehabilitatian plan: Unpublished consultant repart, 30 p.

Lackman and Assaciates, 1976, Enviranmental impact repart, city industrial redevelapment praject: Unpublished cansultant repart, 55 p.

Los Angeles County Flaad Contral, 1974, Setback criteria for rock quan adjacent ta San Gabriel River fram lawer Azusa Raad ta Arraw Highw Unpublished, 24 p.

Miller, R.V., and Carbaley, R., 1980, Mineral land classification of the grec Los Angeles area; Part III, Description of the mineral land classificat of the Orange County-Temescal Valley P-C Region: California Divis of Mines and Geology Special Report 143, Part III, 20 p.

Morton, D.M., 1973, Geology af parts af the Azusa and Mount Wil quadrangles, San Gabriel, Mountains, Los Angeles County, Califarr Califarnia Divisian af Mines and Geolagy Special Report 105, p. 2

Olmsted, F.H., 1950, Gealogy and oil prospects of western San Jase H Los Angeles County, California: California Journal af Mines and Ge ogy, California Division of Mines and Geology, v. 46, no. 2, p. 191-2

Quarles, M., Jr., 1941, Geology af the Repetto and Mantebello Hills: Calil nia Institute af Technalagy, Unpublished M.S. thesis, map scale 1:24,0

Reese, R.G., 1943, Mantebella area af the Montebello ail field, gealo formatians and economic development of the oil and gas fields of Calil nia: Califarnia Division of Mines Bulletin 118, p. 340-342.

Rogers, T.H., 1967, Geologic map of California, San Bernardino she Califarnia Divisian of Mines and Gealagy, scale 1:250,000.

Shelton, J.S., 1955, Glendora volcanic rocks, Los Angeles basin, Califarr Bulletin of the Geolagical Society of America, v. 66, p. 45-90, map sc 1:24,000.

Sauthern Califarnia Rack Products Associatian, 1974, Tour of Las Ange and Orange Counties: Unpublished, 29 p.

Sauthern Califarnia Association of Gavernments, 1978, Draft growth fc cast palicy, 72 p.

The Pipestone Group, 1977, Chandlers Palos Verdes Sand and Gravel C pany Lomita Pit reclamatian plan: Unpublished consultant report, 2

Waadfard, A.O., and others, 1954: Geology af the Los Angeles Ba California Division of Mines Bulletin 170, v. 1, chapter II, p. 65-81.

Waadring, W.O., and others, 1946, Geology and paleantology of the Pc Verdes Hills, California: U.S. Gealagical Survey Prafessional Paper 2 145 p.

U.S. Army Engineer District Los Angeles, Carps of Engineers, 1975, Angeles Caunty drainage area, California, San Gabriel River, Santc Dam recreatian master plan: 61 p.

Yerkes, R.F., 1972, Geology and ail resaurces of the western Puente I area, sauthern Califarnia: U.S. Geological Survey Professianal Pc 420-C, 62 p., scale 1:24,000.

Yerkes, R.F., McCullah, E.H., Schoellhamer, J.E., and Vedder, J.G., 19 Gealagy of the Las Angeles Basin, Califarnia: U.S. Geological Sur Prafessianal Paper 420-A, 57 p., scale 1:24,000.

THIS BOOK IS DUE ON THE LAST DATE
STAMPED BELOW

BOOKS REQUESTED BY ANOTHER BORROWER
ARE SUBJECT TO RECALL AFTER ONE WEEK.
RENEWED BOOKS ARE SUBJECT TO
IMMEDIATE RECALL

LIBRARY, UNIVERSITY OF CALIFORNIA, DAVIS

D4613 (12/76)

TN 24
C 3
A 33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA - EDMUND G. BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D. JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

SPECIAL REPORT 143
PLATE 4.1

San Fernando Valley P-C Region (Special Report 143 Part II)

San Gabriel Valley P-C Region (Special Report 143 Part IV)

* Claremont-Upland P-C Region

Orange County - Temescal Valley P-C Region (Special Report 143 Part III)

unzoned

UNZONED

OFFSHORE SAND AND GRAVEL DEPOSITS

EXPLANATION

MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.

MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence.

MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.

MRZ-4 Areas where available information is inadequate for assignment to any other MRZ-Zone.

* All MRZ areas within the Claremont-Upland P-C region are preliminary and will receive more attention at a later date when this P-C region is studied in detail.

PRODUCTION-CONSUMPTION REGION BOUNDARY

SCALE 1:500,000

0 10 20 30 MILES

0 10 20 30 40 KILOMETERS

GENERALIZED AGGREGATE RESOURCE CLASSIFICATION MAP

SAN GABRIEL VALLEY AND ADJACENT PRODUCTION-CONSUMPTION REGIONS

By: S.L. Kohler, R.C. Loyd, R.V. Miller, and T.P. Anderson

1982

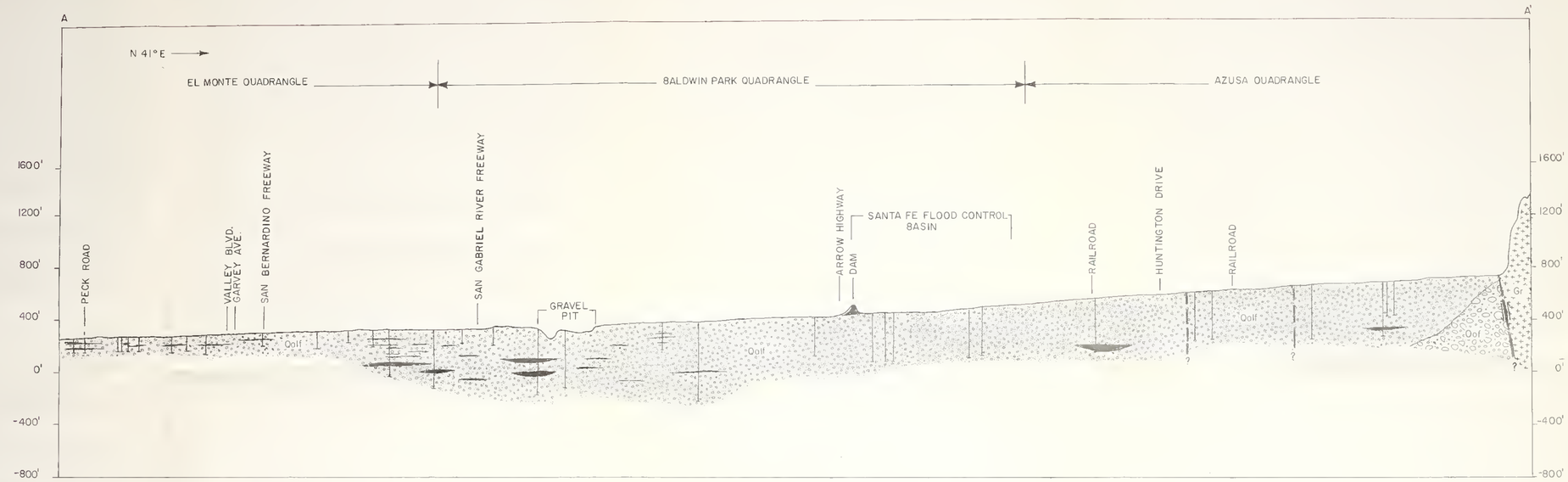
Base Map by U.S. Geological Survey

TN27
C3
R33

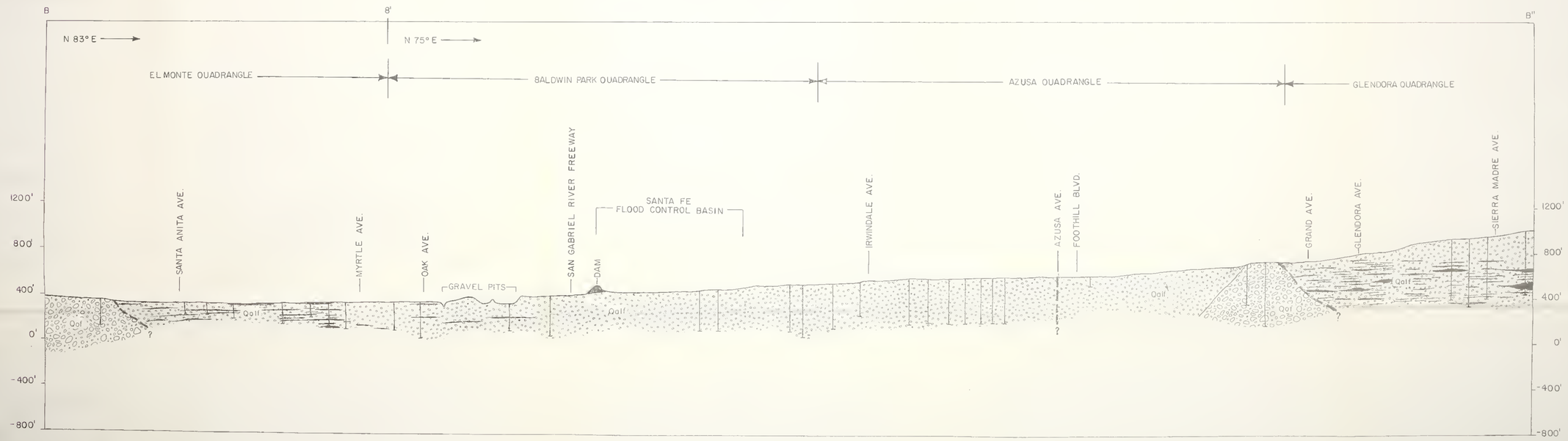
CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA - EDMUND G. BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D. JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

SPECIAL REPORT 143
PLATE 4.2



NOTE: SEE PLATE 4.3 FOR SECTION LINES



EXPLANATION

CENOZOIC — QUATERNARY — PLEISTOCENE HOLOCENE

Qalf — Holocene alluvial fan deposits: predominantly sand and gravel, clay lenses shown where observed in, or interpreted from well log data (dark pattern).

Qof — Dissected Pleistocene alluvial fan deposits consisting generally of clay, silt, sand, and gravel which is massive to poorly bedded and deeply weathered.

MESOZOIC — JURA-CRETACEOUS

Gr — Mesozoic intrusive igneous rocks: predominantly quartz diorite.

MAP SYMBOLS

Drill hole

Fault-dashed where questionable (arrow indicates relative movement).

Geology taken from: Jennings and Strand (1969); Morton (1973); Rogers (1967); and unpublished water well log data, Los Angeles Flood Control District.

HORIZONTAL SCALE
1:24,000

VERTICAL EXAGGERATION
5:1

0 2000' 4000'

800' 600' 400' 200' 0

MINERAL LAND CLASSIFICATION OF THE GREATER LOS ANGELES AREA
SAN GABRIEL VALLEY PRODUCTION CONSUMPTION REGION

SAN GABRIEL FAN, GENERALIZED GEOLOGICAL SECTIONS SHOWING SAND AND GRAVEL DISTRIBUTION

By: S.L. Kohler and R.C. Loyd

1982

TN 21
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA – EDMUND G. BROWN JR., GOVERNOR
THE RESOURCES AGENCY – HUEY D. JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION – JAN DENTON, DIRECTOR

SPECIAL REPORT 143
PLATE 4.3

118°00' R.11W. R.10W. 117°52'30"

34°07'30" T.1N T.1S

MRZ-3
MRZ-2
San Gabriel Valley P.C. Region
MRZ-3
SECTOR A
SECTOR A
MRZ-3
MRZ-3
MRZ-2
SECTOR B
MRZ-2
MRZ-4
MRZ-4
SECTOR C
MRZ-4
SECTOR A
MRZ-2
MRZ-2
MRZ-3
MRZ-2
SECTOR D
MRZ-3
MRZ-3
SECTOR E
SECTOR D
MRZ-2
SECTOR E
SECTOR D
MRZ-2
MRZ-2
MRZ-1
MRZ-2
MRZ-3
MRZ-2
MRZ-3
MRZ-3
MRZ-1
MRZ-1
MRZ-3
MRZ-3

A A' B B' B" C C'

MONROVIA · ARCADIA · SANTA ANITA PARK · BALDWIN PARK · EL MONTE · AZUSA · GLENDORA · SAN JOSE ADDITION · WEST COVINA · SOUTH HILLS

34°07'30" 5' 2'30" 118°00' R.11W. R.10W. 57'30" 55'

BASE MAP BY U.S. GEOLOGICAL SURVEY

MINERAL LAND CLASSIFICATION OF THE GREATER LOS ANGELES AREA-SAN GABRIEL VALLEY P-C REGION

SAN GABRIEL ALLUVIAL FAN

AGGREGATE RESOURCE SECTORS A-E

S.L. Kohler, R.C. Loyd, and T.P. Anderson

SCALE 1:24000

1/2 0 1 MILE

1000 0 1000 3000 5000 7000 FEET

1 5 0 1 KILOMETER

EXPLANATION

● Drill Hole

1982

A A' Geologic Section Line

Production-Consumption Region Boundary

Mineral Resource Zone Boundaries

Aggregate Resource Sector

N

CALIF.

MT. WILSON · AZUSA · GLENDORA · EL MONTE · BALDWIN PARK · SAN DIMAS

BOUNDARY OF AREA MAPPED

INDEX MAP TO 7 1/2' QUADRANGLES

TN 24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA - EDMUND G. BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D. JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

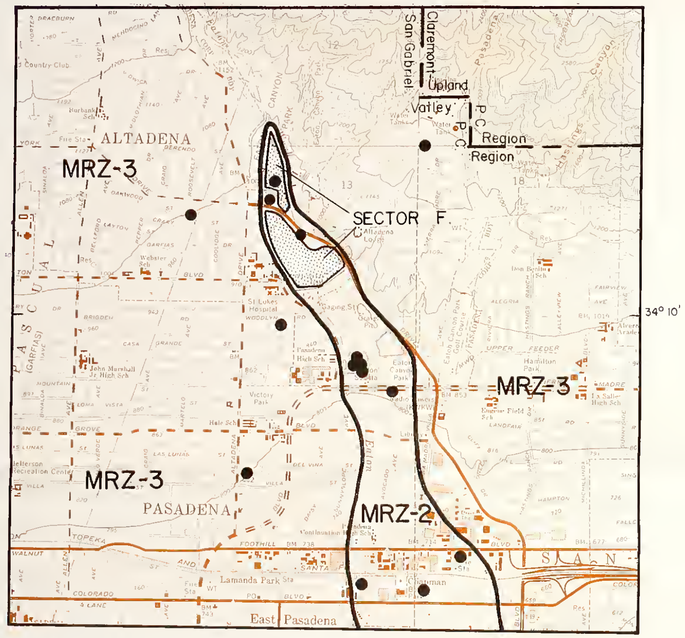
SPECIAL REPORT 143
PLATE 4.4

MINERAL LAND CLASSIFICATION OF THE GREATER LOS ANGELES AREA - SAN GABRIEL VALLEY P-C REGION

EATON WASH, DEVILS GATE RESERVOIR AND PALOS VERDES RESOURCE AREAS

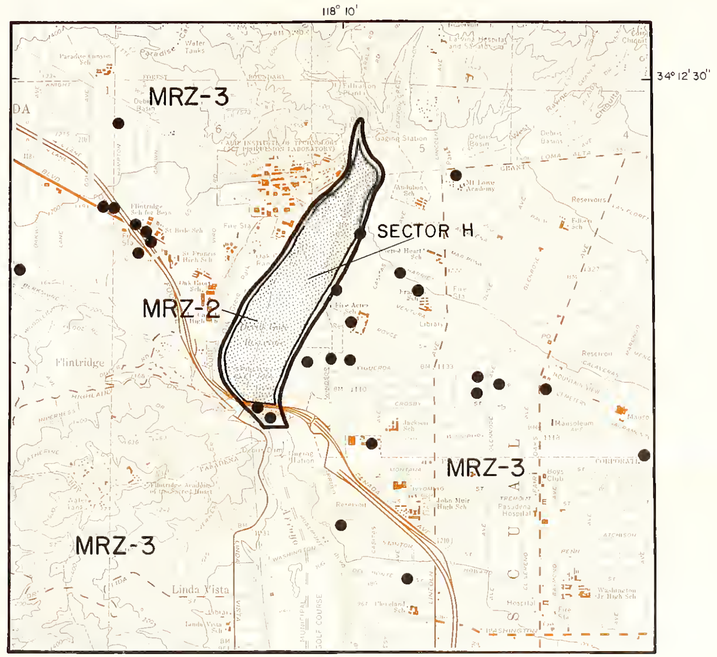
AGGREGATE RESOURCE SECTORS F, G, H, AND I

By S.L. Kohler
1982



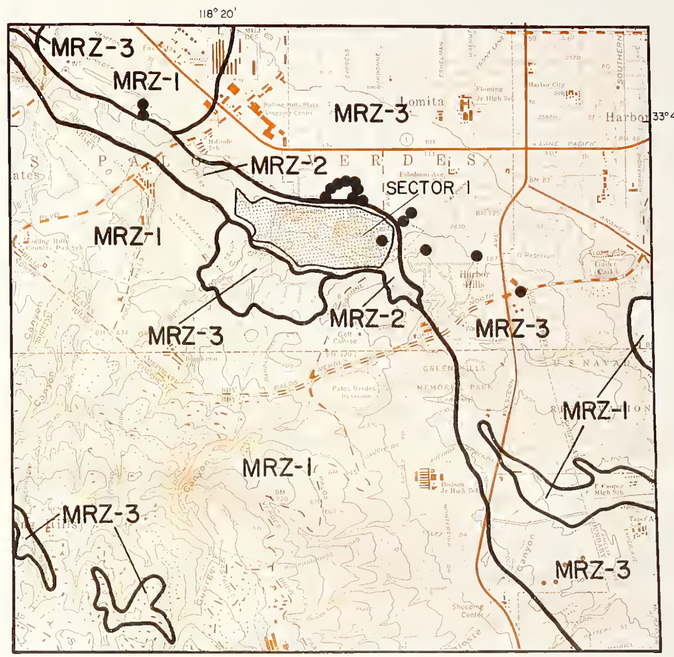
EATON WASH
SECTOR F
(sector G deleted June, 1982)

MT. WILSON QUAD
7 1/2 MINUTE



DEVILS GATE RESERVOIR
SECTOR H

PASADENA QUAD
7 1/2 MINUTE



PALOS VERDES
SECTOR I

TORRANCE QUAD
7 1/2 MINUTE

EXPLANATION

- Drill Hole
- MRZ — Mineral Resource Zone (MRZ) Boundaries
- Aggregate Resource Sector
- Production-Consumption Region Boundary (see text for discussion)

SCALE 1:24 000

1 1/2 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

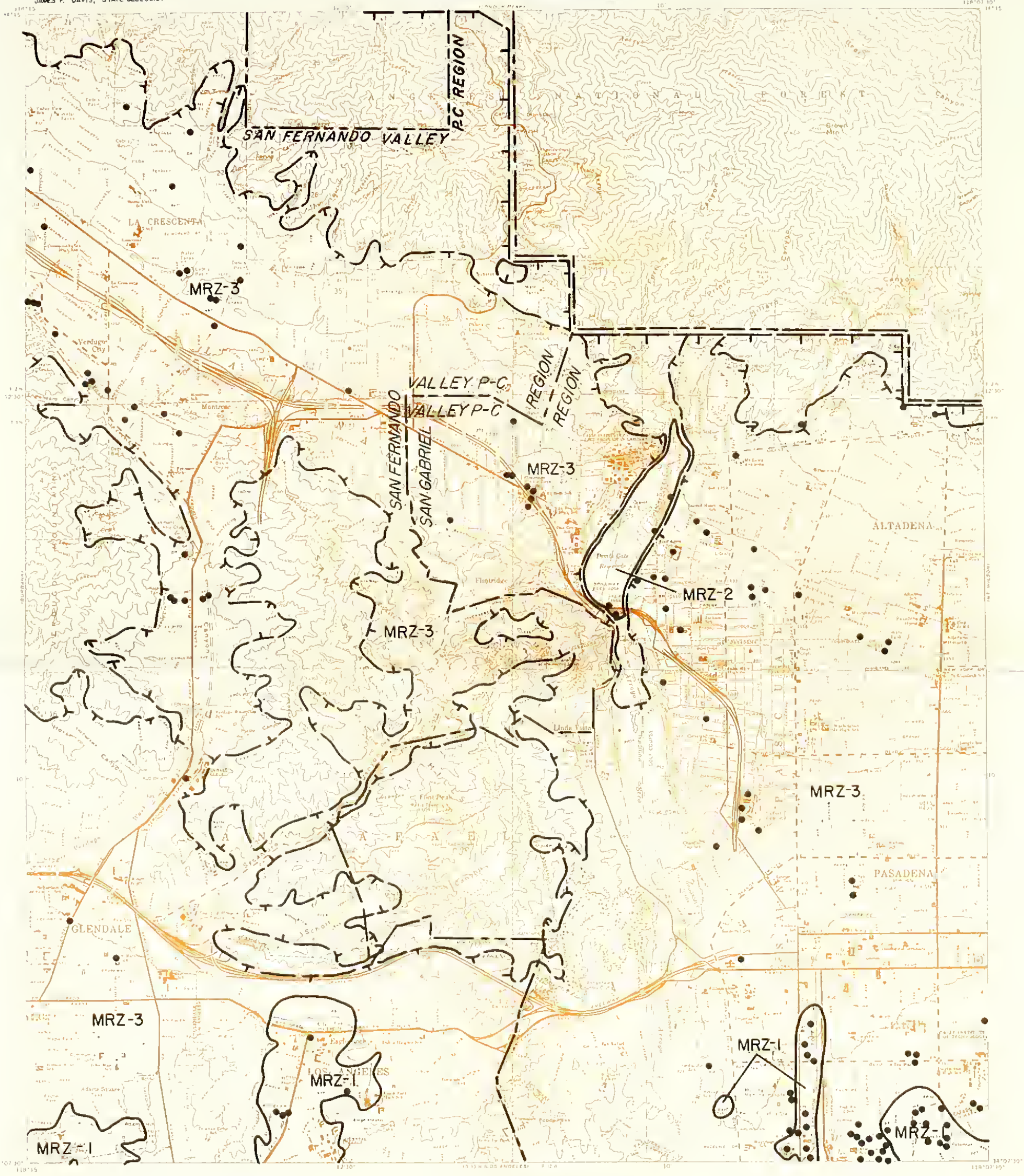
BASE MAP BY U.S. GEOLOGICAL SURVEY

TN 24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA - EDMUND G. BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D. JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

PASADENA QUADRANGLE
SPECIAL REPORT 143
PLATE 4.5



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20 FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

PASADENA, CALIF

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
  Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
- EXISTING URBAN BOUNDARIES
  Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.
- PRODUCTION-CONSUMPTION REGION BOUNDARY
  (see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

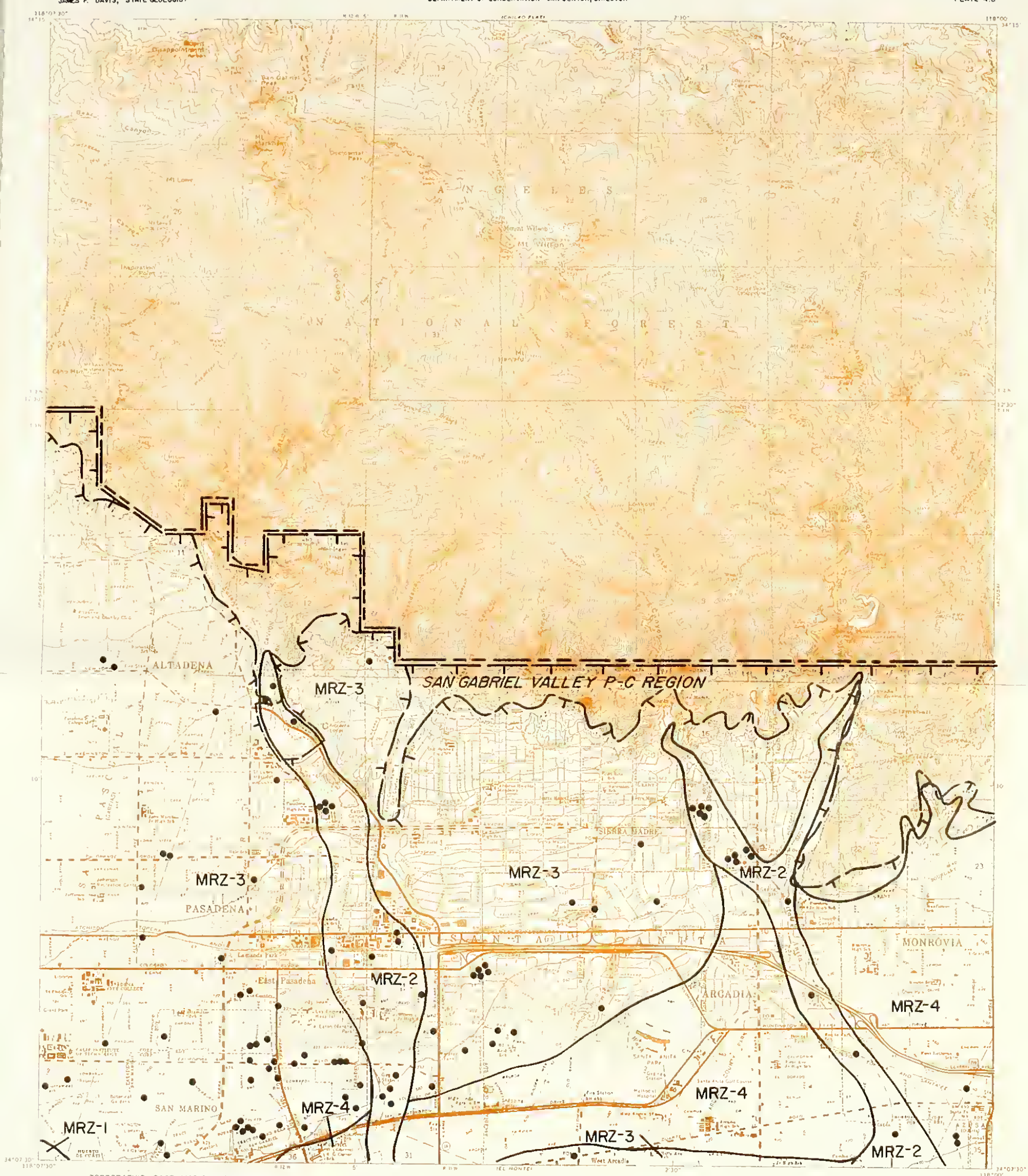
James F. Davis
STATE GEOLOGIST JUNE 1, 1982

TN24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA – EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY – HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION – JAN DENTON, DIRECTOR

MT. WILSON, CALIF.
SPCIAL REPORT 143
PLATE 4.6



TOPOGRAPHIC BASE MAP BY U.S GEOLOGICAL SURVEY

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
  Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
- EXISTING URBAN BOUNDARIES
  Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.
- PRODUCTION-CONSUMPTION REGION BOUNDARY
  (see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

MT. WILSON, CALIF.

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

James F. Davis
STATE GEOLOGIST JUNE 1, 1982

TN24, C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA - EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

ASUSA QUADRANGLE
SPCIAL REPORT 143
PLATE 4.7

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.

MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.

MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.

MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

MRZ-2

See text for additional explanation of MRZ Symbols.

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

AZUSA, CALIF.

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

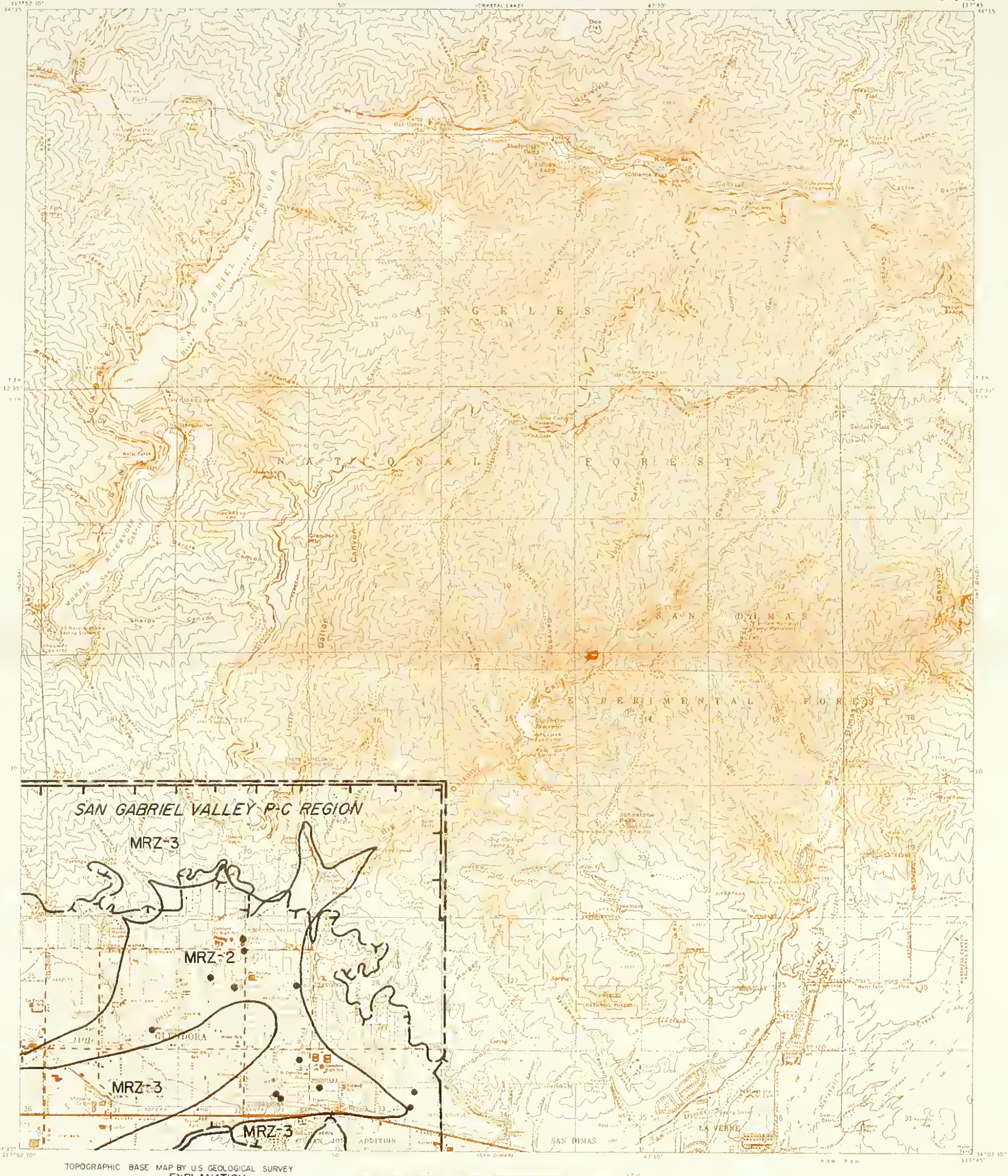
James F. Davis
STATE GEOLOGIST JUNE 1, 1982

TN24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA – EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY – HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION – JAN DENTON, DIRECTOR

GLENDORA QUADRANGLE
SPECIAL REPORT 143
PLATE 4.8



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
  Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
- EXISTING URBAN BOUNDARIES
  Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.
- PRODUCTION-CONSUMPTION REGION BOUNDARY
  (see text for discussion)
- MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

GLENDORA, CALIF

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

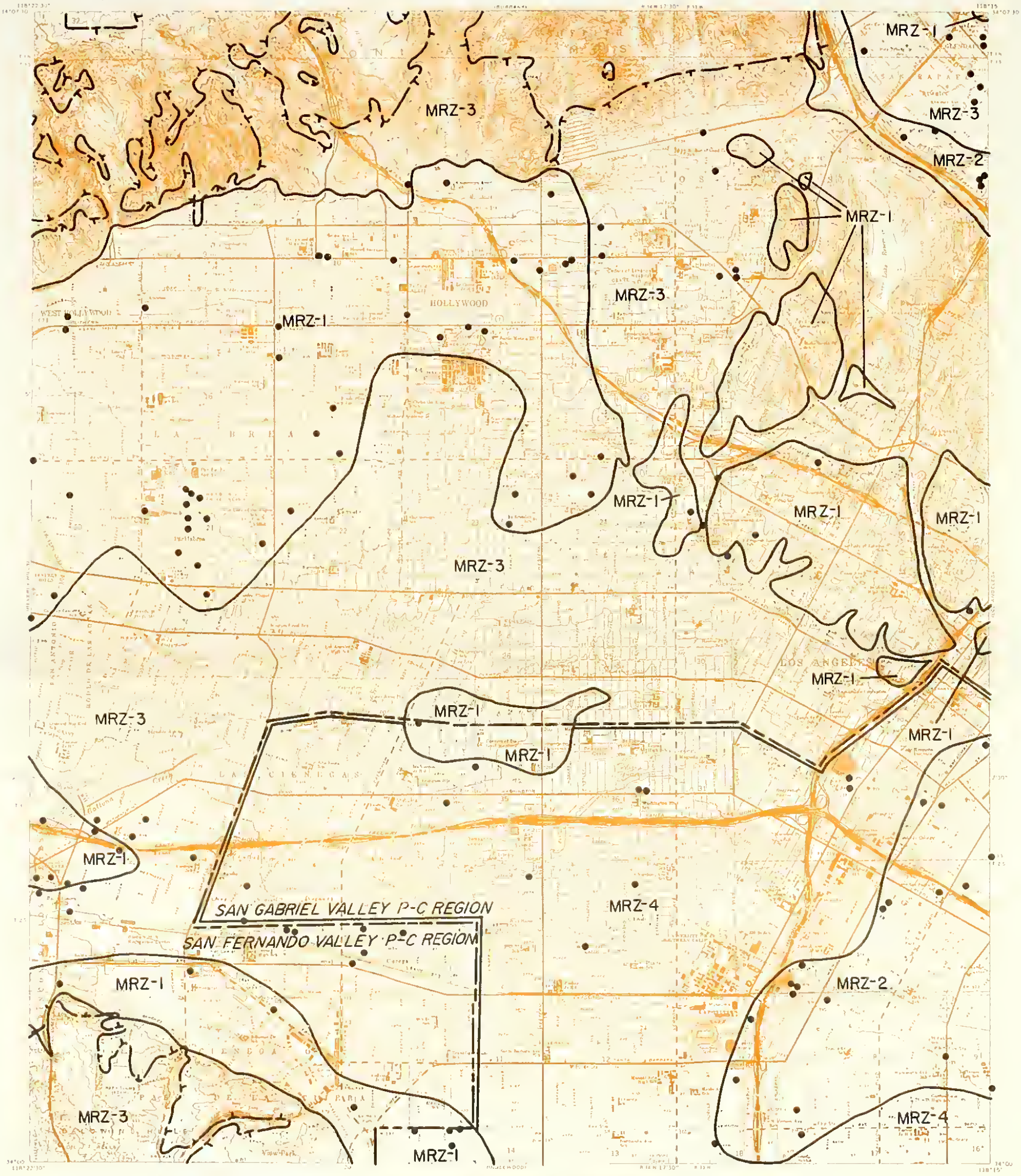
James F. Davis
STATE GEOLOGIST JUNE 1, 1982

TN24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA – EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY – HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION – JAN DENTON, DIRECTOR

HOLLYWOOD QUADRANGLE
SPECIAL REPORT 143
PLATE 4.9



TOPOGRAPHIC BASE MAP BY U.S GEOLOGICAL SURVEY

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

HOLLYWOOD, CALIF

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

James F. Davis
STATE GEOLOGIST JUNE 1, 1992

TN24
C3
A33

STATE OF CALIFORNIA - EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

LOS ANGELES QUADRANGLE
SPECIAL REPORT 143
PLATE 4.10

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

LOS ANGELES, CALIF.

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
  Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
- EXISTING URBAN BOUNDARIES
  Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.
- PRODUCTION-CONSUMPTION REGION BOUNDARY
  (see text for discussion)
- MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

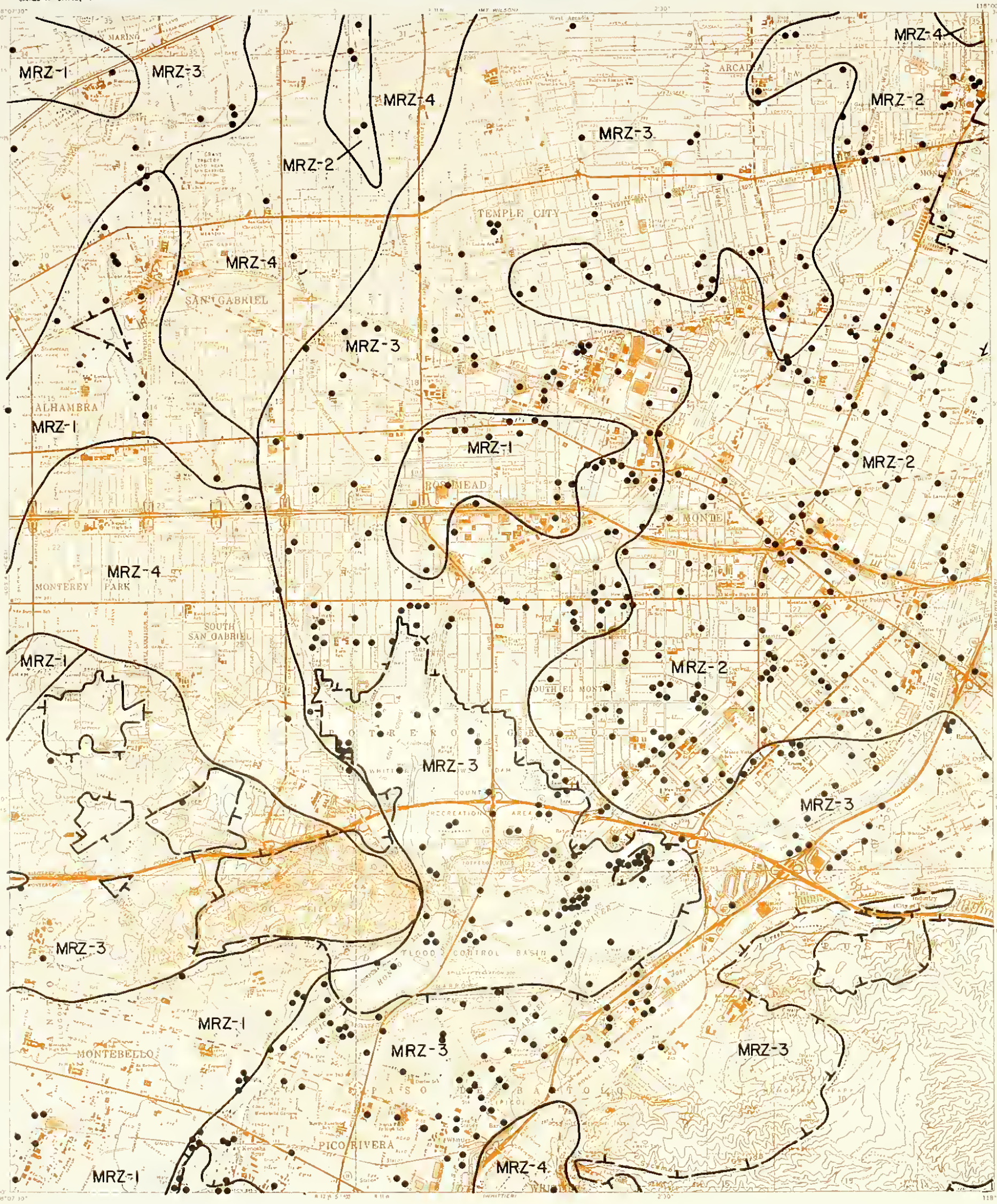
James F. Davis
STATE GEOLOGIST JUNE 1, 1982

TN24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA – EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY – HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION – JAN DENTON, DIRECTOR

EL MONTE QUADRANGLE
SPECIAL REPORT 143
PLATE 4.11



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION — Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
- EXISTING URBAN BOUNDARIES — Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.
- PRODUCTION-CONSUMPTION REGION BOUNDARY (see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 — Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 — Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 — Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 — Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10 FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EL MONTE, CALIF

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

STATE GEOLOGIST JUNE 1, 1982

TN24
~~C3~~
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA – EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY – HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION – JAN DENTON, DIRECTOR

BALDWIN PARK QUADRANGLE
SPECIAL REPORT 143
PLATE 4.12

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
  Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
- EXISTING URBAN BOUNDARIES
  Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.
- PRODUCTION-CONSUMPTION REGION BOUNDARY
  (see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

BALDWIN PARK, CALIF.

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

James F. Davis
STATE GEOLOGIST JUNE 1, 1982

TN 24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA - EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

SAN DIMAS QUADRANGLE
SPECIAL REPORT 143
PLATE 4.13

MRZ-3

MRZ-3

MRZ-2

MRZ-3

MRZ-3

SAN GABRIEL VALLEY P-C REGION

CLAREMONT-UPLAND P-C REGION

SAN DIMAS

LA VERNE

POMONA

COVINA

Puddingstone Reservoir

Walnut

Walnut Siding

Diamond

Industry
(City of Industry PO)

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

SCALE 1:24000

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

SAN DIMAS, CALIF.

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

James F. Davis
STATE GEOLOGIST JUNE 1, 1982

TN24
C3
A33

STATE OF CALIFORNIA – EDMUND G BROWN JR , GOVERNOR
THE RESOURCES AGENCY – HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION – JAN DENTON, DIRECTOR

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

VENICE QUADRANGLE
SPECIAL REPORT 143
PLATE 4.14

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

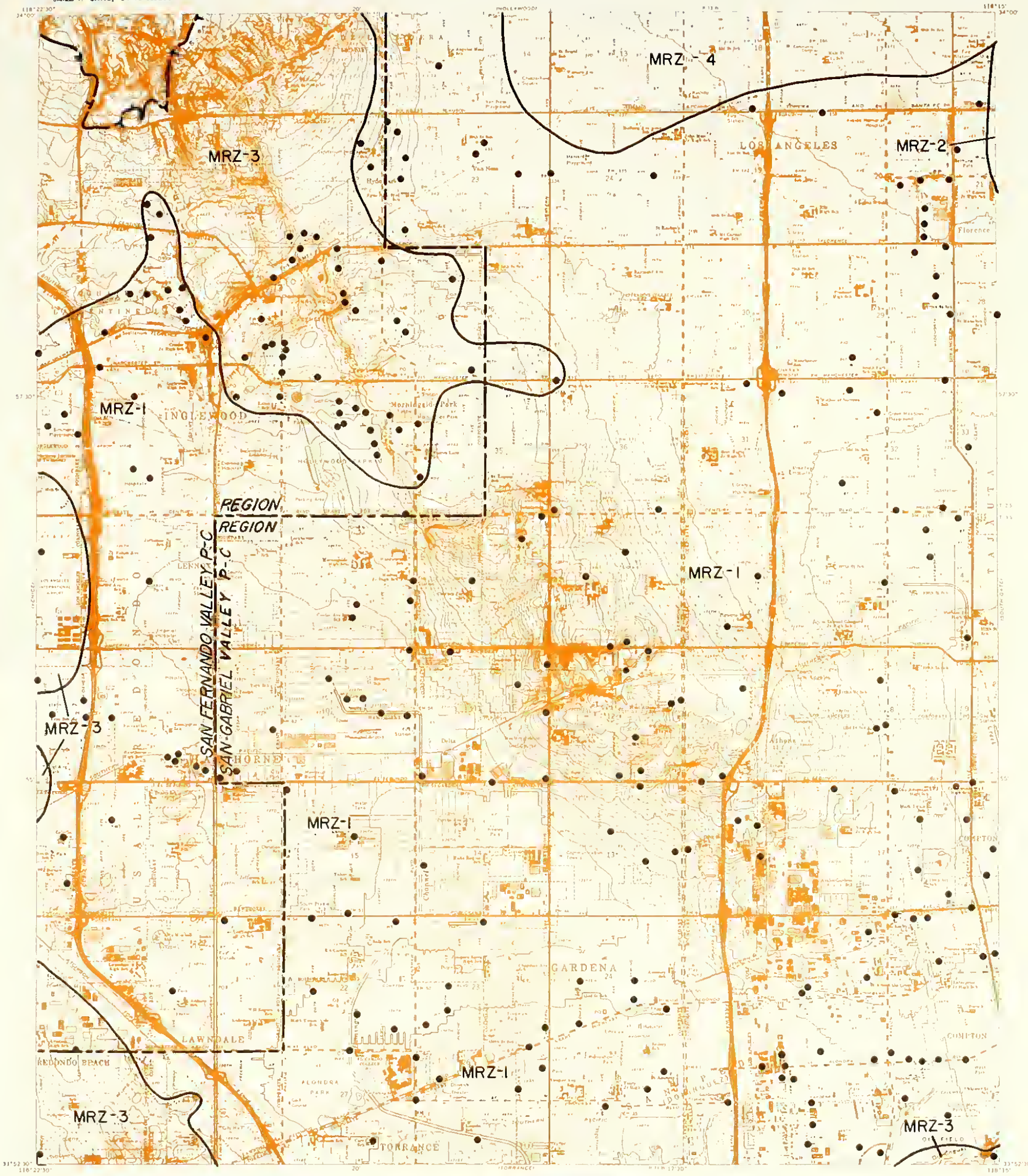
James F. Davis
STATE GEOLOGIST **JUNE 1, 1982**

TN24
C3
A33

STATE OF CALIFORNIA - EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

INGLEWOOD QUADRANGLE
SPECIAL REPORT 143
PLATE 4.15



TOPOGRAPHIC BASE MAP BY U.S GEOLOGICAL SURVEY

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

INGLEWOOD, CALIF.

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

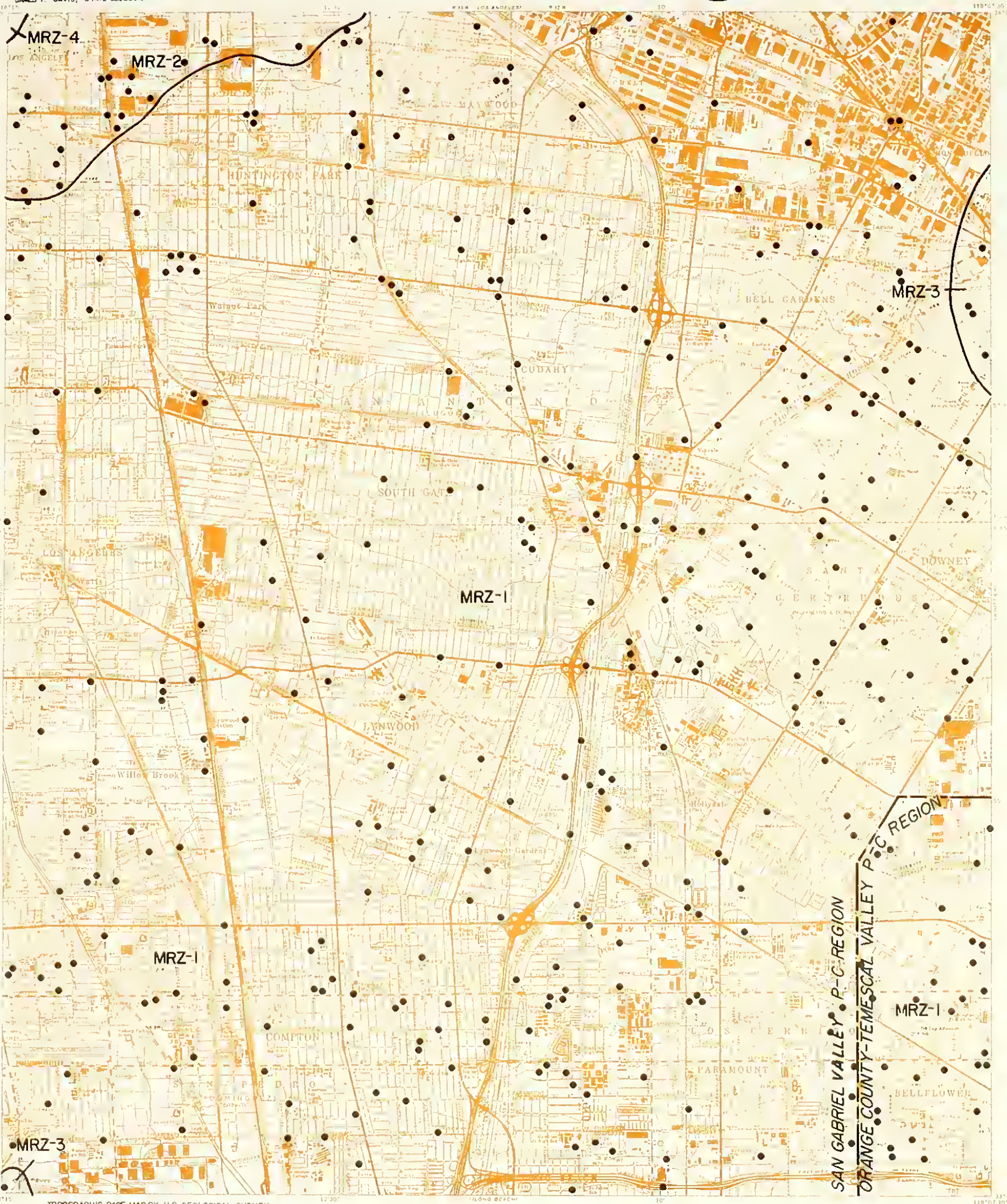
STATE GEOLOGIST JUNE 1, 1982

TN24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA – EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY – HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION – JAN DENTON, DIRECTOR

SOUTH GATE QUADRANGLE
SPECIAL REPORT 143
PLATE 4.16



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

15°
MAGNETIC NORTH
AND DECLINATION

SOUTH GATE, CALIF.

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

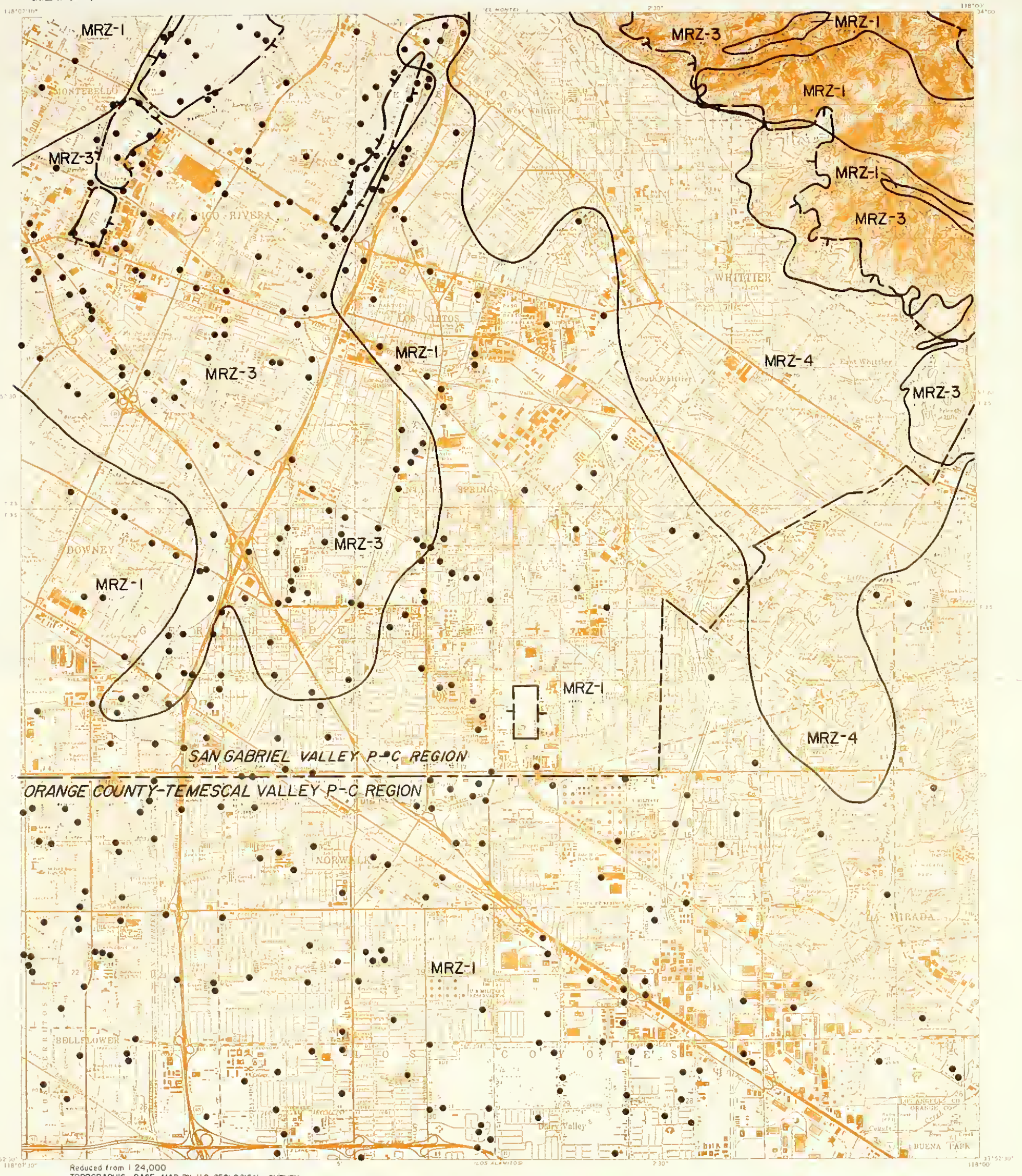
James F. Davis
STATE GEOLOGIST JUNE 1, 1982

TN24
A C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA - EDMUND G BROWN JR, GOVERNOR
THE RESOURCES AGENCY - HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

WHITTIER QUADRANGLE
SPECIAL REPORT 143
PLATE 4.17



Reduced from 1:24,000
TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

WHITTIER, CALIF.

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

James F. Davis
STATE GEOLOGIST JUNE 1, 1982

TN24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA - EDMUND G. BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D. JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

LA HABRA QUADRANGLE
SPECIAL REPORT 143
PLATE 4.18

MRZ-3
MRZ-1
MRZ-3
MRZ-3
MRZ-3
MRZ-1
MRZ-1
MRZ-3
SAN GABRIEL VALLEY P-C REGION
ORANGE COUNTY
CLAREMONT - TEMESCAL
UPLAND P-C REGION
VALLEY P-C REGION
MRZ-3
MRZ-1
MRZ-4
MRZ-3
MRZ-3
MRZ-3
MRZ-1
MRZ-1
MRZ-1
MRZ-3
MRZ-3
MRZ-3

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.

MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.

MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.

MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

15°

MAGNETIC NORTH
AND DECLINATION

LA HABRA, CALIF

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

James F. Davis
STATE GEOLOGIST JUNE 1, 1982

TN24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA - EDMUND G. BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D. JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

REDONDO BEACH QUADRANGLE
SPECIAL REPORT 143
PLATE 4.19

MINERAL LAND CLASSIFICATION MAP

AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

STATE GEOLOGIST JUNE 1, 1982

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

MRZ-3
MRZ-3
MRZ-3
MRZ-1
MRZ-3
S.F. VALLEY P-C REGION
SAN GABRIEL VALLEY P-C REGION
HERMOSA BEACH
REDONDO BEACH
REDONDO CANYON
SANTA MONICA BAY
PACIFIC

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

CONTOUR INTERVAL 10 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

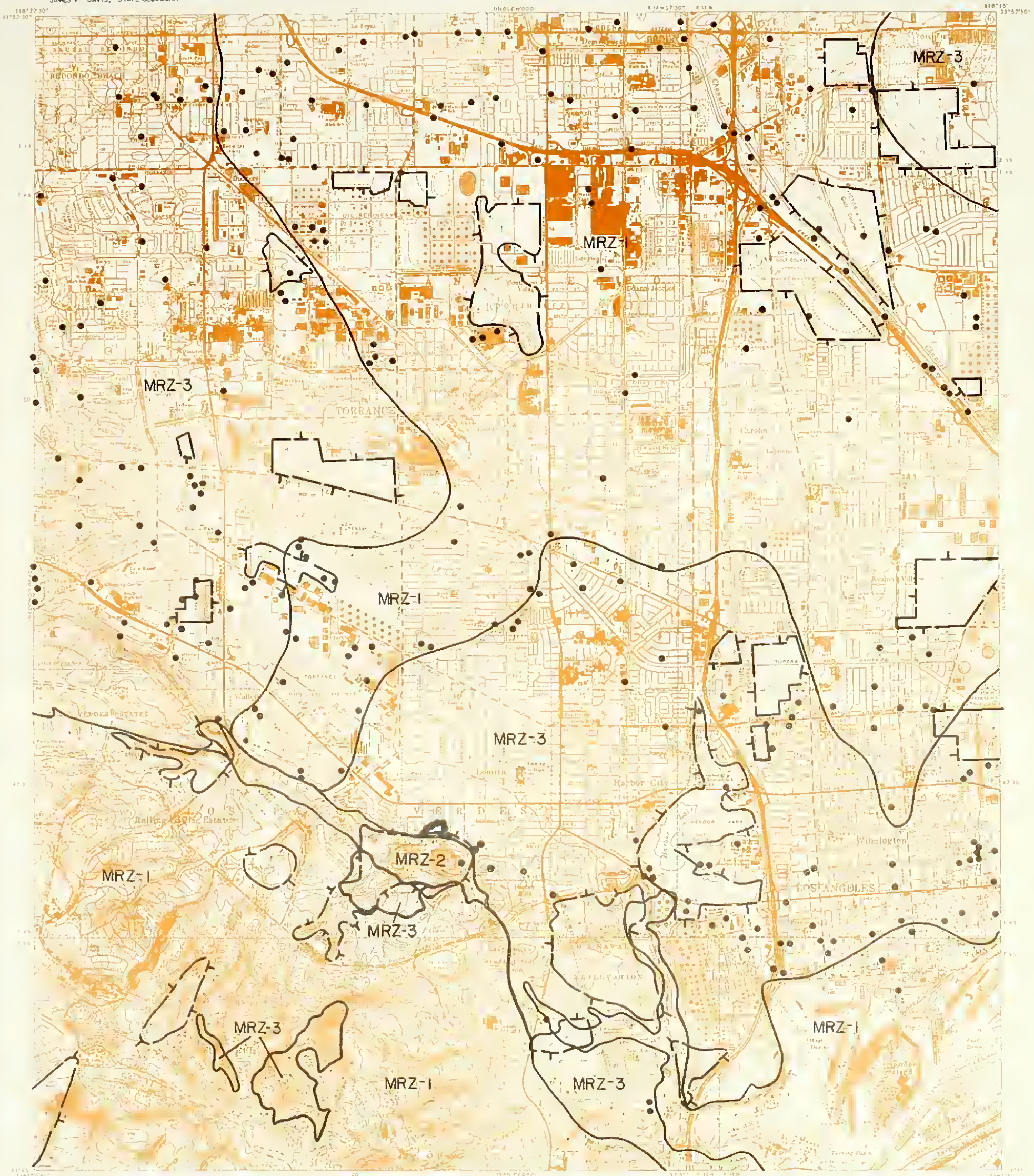
REDONDO BEACH, CALIF.

TN24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA - EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

TORRANCE QUADRANGLE
SPECIAL REPORT 143
PLATE 4.20



TOPOGRAPHIC BASE MAP BY U.S GEOLOGICAL SURVEY

EXPLANATION

Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures tie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures tie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.

MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.

MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.

MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOWER LOW WATER

TORRANCE, CALIF

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

James F. Davis
STATE GEOLOGIST JUNE 1, 1982

TN24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA – EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY – HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION – JAN DENTON, DIRECTOR

LONG BEACH QUADRANGLE
SPECIAL REPORT 143
PLATE 4.21

ORANGE COUNTY-TEMESCAL VALLEY P-C REGION

SAN GABRIEL VALLEY P-C REGION

MRZ-1
MRZ-2
MRZ-3
MRZ-4

EXPLANATION

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

MAGNETIC NORTH AND DECLINATION

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

STATE GEOLOGIST JUNE 1, 1982

TOPOGRAPHIC BASE BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

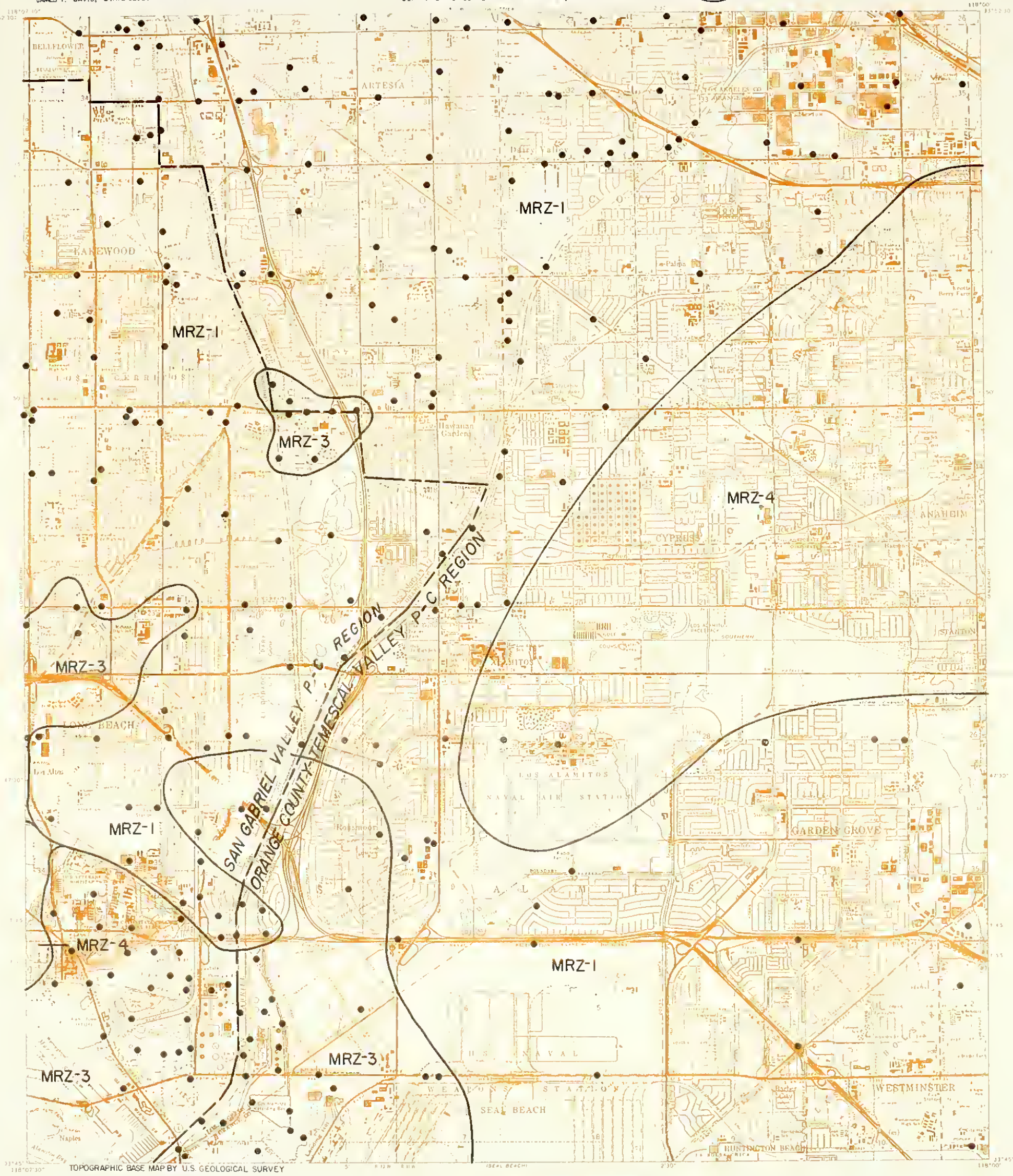
CONTOUR INTERVAL 5 FEET

TN24
C3
A33

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA – EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY – HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION – JAN DENTON, DIRECTOR

LOS ALAMITOS QUADRANGLE
SPECIAL REPORT 143
PLATE 4.22



TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOWER LOW WATER

15°

MAGNETIC NORTH
AND DECLINATION

LOS ALAMITOS, CALIF

EXPLANATION

- Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

STATE GEOLOGIST JUNE 1, 1982

TN24
C3
A33

STATE OF CALIFORNIA - EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

SAN PEDRO QUADRANGLE
SPECIAL REPORT 143
PLATE 4.23

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY

EXPLANATION

- Drill hole

OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.

EXISTING URBAN BOUNDARIES
Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.

PRODUCTION-CONSUMPTION REGION BOUNDARY
(see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10 FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET — DATUM IS MEAN LOWER LOW WATER

SAN PEDRO, CALIF.

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

James F. Davis
STATE GEOLOGIST JUNE 1, 1982

CALIFORNIA DIVISION OF MINES AND GEOLOGY
JAMES F. DAVIS, STATE GEOLOGIST

STATE OF CALIFORNIA - EDMUND G BROWN JR., GOVERNOR
THE RESOURCES AGENCY - HUEY D JOHNSON, SECRETARY
DEPARTMENT OF CONSERVATION - JAN DENTON, DIRECTOR

SEAL BEACH QUADRANGLE
SPECIAL REPORT 143
PLATE 4.24

MRZ-3
MRZ-3
S.G. VALLEY P-C REG.
O.C. - T. VALLEY P-C REG.
MRZ-1
MRZ-3
MRZ-2
MRZ-3
LONG BEACH
SEAL BEACH
HUNTINGTON BEACH
PACIFIC OCEAN

TOPOGRAPHIC BASE MAP BY U.S. GEOLOGICAL SURVEY
Reduced from 1:24,000

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOWER LOW WATER

EXPLANATION

- Drill hole
- OUTER BOUNDARY OF AREAS SUBJECT TO URBANIZATION
  Boundaries established from data supplied by the Office of Planning and Research with modifications developed from information supplied by local government and other sources. Hachures lie within area undergoing urbanization.
- EXISTING URBAN BOUNDARIES
  Boundaries established by the Office of Planning and Research and by data supplied by local government agencies and other sources to reflect present conditions. Hachures lie within urban area.
- PRODUCTION-CONSUMPTION REGION BOUNDARY
  (see text for discussion)

MINERAL RESOURCE ZONE BOUNDARIES

MRZ-2

- MRZ-1 Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.
- MRZ-2 Areas where adequate information indicates that significant mineral deposits are present or where it is judged that a high likelihood for their presence exists.
- MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4 Areas where available information is inadequate for assignment to any other MRZ zone.

See text for additional explanation of MRZ Symbols.

15°
MAGNETIC NORTH
AND DECLINATION

SEAL BEACH CALIF.

MINERAL LAND CLASSIFICATION MAP
AGGREGATE RESOURCES ONLY

PREPARED IN COMPLIANCE WITH THE SURFACE MINING AND RECLAMATION ACT OF 1975, ARTICLE 4, SECTION 2761

STATE GEOLOGIST JUNE 1, 1982